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ABSTRACT

In this second of two studies conducted with portions of the National Speech and Hearing Survey data, the investigators analyzed the phonetic variants from standard American English in the speech of two groups of nonstandard English speaking children. The study used samples of free speech and performance on the Gold-Fristoe Test of Articulation from a group of 192 Black children (grades 1-6 from Niagara Falls, New York, and a group of 192 Mexican-American children (grades 1-6) from San Antonio, Texas. The study reports the frequencies of omission, substitution, and distortion. The present data is compared with the previously reported results obtained from standard American English speakers from Marshall, Iowa. The major conclusion is that all phonetic variations from standard American English can be attributed to one of the following sources of variation: (1) reduction in the complexity of segments, which usually decreases with age; (2) differing phonological rules between standard English and a dialect of English; and (3) phonetic interference between a foreign primary language and English. (See also ED 042 756, ED 042 757, ED 042 758, ED 046 938, ED 052 213) (CF)

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AN ANALYSIS OF THE VARIATIONS FROM STANDARD ENGLISH PRONUNCIATION IN THE PHONETIC PERFORMANCE OF TWO GROUPS OF NONSTANDARD-ENGLISH-SPEAKING CHILDREN

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TABLE OF CONTENTS

		Page
FOREWORD		iv
ABSTRACT		v
Section		
1.	INTRODUCTION	1
	1.1. Overall Research Plan	1
	1.2 Phase I	1
	1.3 Phase II	2
2.	PREDICTED VARIATION IN SPEAKERS OF BLACK AND MEXICAN-AMERICAN ENGLISH	5
	2.1. Theoretical Considerations	6
	2.2. Results from Marshalltown Study	6
	2.3. Published Work on Black and Mexican-American Dialect	9
	2.4. Published Work on Mexican-American Dialect	11
3.	DATA COLLECTION AND INITIAL TABULATION	15
	3.1. National Speech and Hearing Survey Data Collection	15
	3.2. Procedure for the present Study	15
	3.3. Two Excluded Phonemes	16

Section Page

4. RESULTS 19

4. 1. Niagara Falls: The Black Sample. 20

4. 2. San Antonio: The Mexican-American Sample . . . 95

5. DISCUSSION 177

5. 1. Evaluations of Empirical Predictions 177

5. 2. Sociolinguistic Implications 180

5. 3. Implications for Linguistic Theory 182

REFERENCES. 185

APPENDIX A 187

APPENDIX B 205

FOREWORD

This monograph reports the second and final phase of a research project based on speech data collected from United States schoolchildren by the National Speech and Hearing Survey. The project -- a phonological analysis of articulatory variants on Standard American English -- was initiated in June, 1970, with a study of standard English-speaking schoolchildren in Marshalltown, Iowa. The results of that first phase were published January, 1971, in a monograph entitled Analysis of Production Errors in the Phonetic Performance of School-Age Standard-English-Speaking Children. This second -- an analysis of the speech of two groups of nonstandard-English-speaking children -- was initiated January, 1971.

We are indebted to Dr. Forrest Hull, Director of the National Survey, for his cooperation in carrying out this research. Consultants Dr. Roger Shuy, Dr. Walter Stoltz, and Dr. Diana Natalicio aided in the planning stages. Dr. Helen Cairns undertook the day-to-day management of the project. Dr. Charles Cairns served as the main linguistic consultant. Graduate assistants serving as typists and phonetic coders included Roslyn Freeman, Karen Hodges, Leslie Miller, Linda Sobin, and Kathleen Scimeca.

Frederick Williams
Project Director

July, 1971

ABSTRACT

In this study the phonetic variants of Standard American English in the speech of two groups of nonstandard-English-speaking children were analyzed. The study included a group of 192 Black children (grades 1-6) from Niagara Falls, New York, and a group of 192 Mexican-American children (grades 1-6) from San Antonio, Texas, Speech samples were obtained by the National Speech and Hearing Survey and were samples of both Free Speech and of performance on the Goldman-Fristoe Test of Articulation. This study is the second in a series of two studies conducted on portions of the National Speech and Hearing Survey data. The first investigated the speech of a sample of standard-English-speaking children from Marshalltown, Iowa.

This monograph reports frequencies of omissions, substitutions, and distortions across grade levels for both groups. Greatest emphasis, however, is placed on the analysis of substitutions according to target phoneme, substituted phoneme, and phonetic features involved in each substitution. A cluster of substitutions was found to be common to all three groups of speakers (considering both studies together); another cluster was found to be unique to the Black and Mexican-American speakers; one substitution was characteristic only of the Mexican-American group.

A major conclusion of this two-part study is that all phonetic variations from Standard American English can be explained by appeal to one of the following three sources of variation:

(1) Variation attributable to a reduction in the complexity of segments, which usually decreases with age. Almost all variations of this type can be explained by a phonological theory incorporating the ideas of markedness theory.

(2) Variation attributable to the differing phonological rules between Standard English and a dialect of English, such as Black English.

(3) Variation attributable to phonic interference between a foreign primary language and English. This interference can be either purely articulatory or can be derived from perceptual inconsistencies resulting from competing perceptual cues in the two languages.

SECTION 1

INTRODUCTION

The research reported here is the second phase of a research project designed to analyze phonetic variations from Standard American English produced by selected groups of school children in the United States. In the total project three dialect areas have been investigated. The first phase (Williams(Ed.), Cairns, Cairns, & Blosser, 1971) dealt with children from Marshalltown, Iowa, grades 1-12 judged to be a Standard English dialect area. This second phase has investigated a group of Black children in Niagara Falls, New York, (grades 1-6) and a group of Mexican-American children in San Antonio, Texas (grades 1-6) whose native language is Spanish.

1.1. Overall Research Plan

The total research project has had a number of convergent goals, both theoretical and empirical. First, it was important to ascertain the relative incidence of the various types of phonetic variants (i.e., omissions, distortions, and substitutions) in each of the three groups. The orientation of the research, however, has been toward an analysis of the instances in which one phoneme is substituted for another. The strategy of analysis has been to describe each phoneme as a bundle of phonetic features (Chomsky and Halle, 1968). The substitution is then characterized as a change in the value of certain of the features. The stability of individual features and the inter-relationships among them are being studied.

1.2. Phase I

An important theoretical contribution of the first phase of this research was to evaluate a linguistic theory of phonemic inventories incorporating the concept of markedness. Such a theory assigns complexity values to phonetic features and predicts the relative complexity of various phonemes. The marking conventions specified by linguistic theory were supported by the data from the Marshalltown children. In almost every instance the substituted phoneme was less complex than the target phoneme which it replaced. It is important to note that the "complexity" referred to by markedness theory is not simply the opposite of "ease of articulation". Relative complexity in markedness theory derives from a number of sources, including perceptual distinctiveness, the frequency of occurrence of certain phonemes among

languages of the world, and physiological considerations such as deviation of the vocal apparatus from phonetic neutral position. For a complete discussion of the Marshalltown data and its explanation within the markedness framework, see Williams, et al. (1971). Appendix A of the current report presents the theoretical framework on which those analyses were based.

1.3. Phase II

Substitution data collected in this second phase of the research project provided a further test of the theoretical framework supported by the Marshalltown data. In addition, the generality of the phase one statements regarding the stability and inter-relationships among the phonetic features were evaluated by the data from the two new dialect areas.

The second phase, however, had a more pronounced empirical orientation than did the Marshalltown study. In the present study we were dealing with two quite different types of nonstandard English speech. One of these referred to as Black English (hereafter BE), is commonly regarded as a dialect of English by sociolinguists. We accept all the assumptions which researchers in BE traditionally adopt, i.e. that BE is a true dialect in the sociolinguistic sense. Furthermore, we anticipated that the speech of the children of Niagara Falls would show certain aspects characteristic of BE. The speech of the Mexican-American sample, however, probably cannot be regarded as a dialect of Standard English in the traditional sociolinguistic sense. There is a large population of Mexican-Americans in the Southwest who are either fully bilingual Spanish-English in the home or who have Spanish as the primary language in the home and adopt English as the language of the community. The English of this population shows certain characteristics (which will be discussed in detail in the next section) resulting from the fact that English is either learned simultaneously with or is superimposed upon their native Spanish. It is this characteristic speech which we address in the present study and which we shall refer to as Mexican-American English (hereafter MAE).

A number of publications dealing with Black and Mexican-American dialects allow predictions about what variations will be revealed in the study. (Section 2 of this report is devoted to a presentation of the relevant literature and predictions.) There have been no large-scale quantitative studies, however, to ascertain exactly what kinds of variation, and in particular what kinds of substitutions, (and the incidence of both,) are associated with these dialects of English.

When both phases of the total project are considered together, it is reasonable to expect that a small core of variations common to the three dialect groups will emerge. These variations might decrease with age, but should certainly be expected to remain at some constant frequency even

into the adult population. In addition, it seems reasonable to anticipate that each dialect group will have a few types of variations which do not occur in the other two groups.

The subjects for this project were subsamples of school children interviewed by the National Speech and Hearing Survey, conducted in 1968. Relevant details of the conduct of that survey as well as an explication of the methods involved in the present research are presented in the third section of this report. Sections 4 and 5 will consist of results and conclusions, respectively.

SECTION 2

PREDICTED VARIATION IN SPEAKERS OF BLACK AND MEXICAN-AMERICAN ENGLISH[1]

It is possible to make predictions about what substitutions will occur in both the Black and the Mexican-American dialect populations. There are, essentially, three kinds of sources for these expectations. (1) Theoretical considerations presented in Appendix A; (2) Substitutions reported from the Marshalltown study. These substitutions presumably represent performance errors attributable for the most part to an immature vocal apparatus; (3) Published work describing characteristics of Black and Mexican-American dialects. This latter source demands a bit of additional discussion. In the case of the native speakers of Spanish, substitutions can be predicted on the basis of phonetic interference (Weinreich, 1957) in a fairly straight-forward manner. Variants produced by Mexican-American children presumably result from the fact that Spanish and English have different phonemic inventories and the areas of non-overlap produce phonetic variation and perhaps misperceptions as well. This subject will be treated in some detail below when variant predictions for the Mexican-American group are discussed more fully.

Literature dealing with Black dialect is, clearly, not so straightforward. The "difference vs. deficit" controversy rages so intensely that it is questionable whether one is justified in referring to "substitution errors" (Williams, 1970). Many sociolinguists would much prefer the characterization that the black dialect specifies or allows different realizations of certain phonemes in certain positions than does Standard American English (SAE). Henceforth, this report will refer to "variants of SAE," rather than to "errors" or "misarticulations." The research of Labov and his colleagues has shown that the variations from Standard English are by no means an all-or-none phenomenon. His discovery of the social stratification of a number of phonological variables (Labov, 1966) shows that in many cases dialect differences are in actuality standard variations which vary quantitatively (rather than qualitatively) according to the race, social class and performance modality (i. e. whether reading aloud or talking conversationally) of the speaker.

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[1]The authors would like to thank Linda Sobin for assistance in researching and reporting the literature discussed in this section.

Literature dealing with Black English (BE), then, is of an entirely different character than the literature dealing with that dialect of English spoken by native speakers of Spanish (i. e., Mexican-American English, MAE).

Mexican-American English is predicted by the comparison of two well-researched languages. Black English on the other hand, is an unwritten language, long rejected as merely an inferior version of SAE. Only recently has the structure and order of Black English been recognized and described. A great deal of work remains to be done before Black English and its relationship to SAE is fully understood. However it is clear that the relationship is a complex combination of sociological, cultural and linguistic factors.

The goal of the present research project is to compare the variants of Standard English produced by children who speak MAE with those of children who speak BE. The making of such a comparison necessitates that consideration of the differential sources of Black and Mexican-American dialects be held in abeyance.

The remainder of this section will be devoted to exploring the three available sources of prediction of variation from SAE in the present study.

2. 1. Theoretical Considerations

Appendix A presents a linguistic theory of phonemic inventories incorporating the notions of markedness. Such a theory predicts that in the case of articulatory substitutions, less complex speech sounds will be substituted for more complex ones. This hypothesis was confirmed by the Marshalltown data. The Marshalltown children, however, made few errors overall. A larger error corpus would represent a much more stringent test of the complexity hypothesis, as many predictions derivable from markedness theory were neither falsified nor confirmed by the Marshalltown data. For instance, the theory predicts that /k/ would be substituted for /g/. In the Marshalltown data, however, /g/ was omitted twice in the Goldman-Fristoe data, but it was never the victim of a substitution error. Only in a corpus with more phonetic variation could some predictions be confirmed or falsified.

2. 2. Results from Marshalltown Study

Table 1 shows all variants which occurred more than twice in the Marshalltown Goldman-Fristoe data. It was expected that most, if not all, these variants would occur in the BE and MAE groups. Underlying the use of the Marshalltown data as a prediction device for the present study is the assumption that those errors are attributable to the immature articulatory capabilities of the subjects, rather than to dialect deviance from SAE in the speech community.

Table 1

Variants Occurring more than Twice in the Goldman-Fristoe Data of Speakers of SAE in Grades 1-12 (from Williams, et al., 1971)*

Target Phoneme	Variant	f	+/- Feature Change	M/U Feature Change
f	b	6	-cnt; +voi	M ant; U cnt M voi; U str
v	b	29	-cnt	M cor; U cnt; U str
ð	d	18	-cnt	U cor; U cnt; U str
θ	f	21	-cor	U cor
	t	5	-cnt	U cor U cnt; U str
	s	4	+str	U cor; U str
	omit	5		
z	s	42	-voi	U voi
s	distort	8		
	omit	3		
š	č	8	-cnt	U cnt
	s	3	+ant	U ant; U cor
č	t	6	+ant, -str	U ant U cor; U str
	š	5	+cnt	M cnt

Table 1 (cont'd)

Target Phoneme	Variant	f	+/- Feature Change	M/U Feature Change
ǰ	č	6	-voi	U voi
	d	3	+ant; -str	U ant; U cor
r	w	31	-cns; -ant -voc; -cor	none
	omit	10		
l	w	6	-cns; -voc -ant; -cor -lat	U lat
	omit	8		
p	b	7	+voi	M voi

*In the columns indicating feature changes the feature values given are those of the substituted phoneme which differ from those of the target phoneme. Notice that a feature may change in marking value without changing in +/- value (see, for instance, the /b/ for /f/ substitution).

In the Marshalltown study the data were not organized according to position of the target phoneme, as they are in the present study.

The target /r/ includes both the true consonantal /r/ and the vocalic /ɚ/. These two phonemes are treated separately in the present report.

For an explanation of the phonetic features and their abbreviations, see Table 1, Appendix A.

This is a good place to note, also, that all variants discussed in this research project are assumed to be attributable to linguistic performance, not necessarily reflecting the basic linguistic competence of the individuals involved in the study. It is not advisable to make strong claims about an individual's linguistic competence based on information about his linguistic output alone. In the case of the Black and Mexican-American subjects in this study, however, many of the variations from SAE which they exhibit may well be the reflection of different internalized grammars. Labov (1970), Wolfram (1970), and others have been concerned with the development of appropriate formal mechanisms to account for the competence of speakers of dialects and idiolects which differ from SAE. However, data such as these collected by the present study cannot be construed as directly relevant to such theoretical issues.

2.3. Published Work on Black and Mexican-American Dialect

2.3.1. Studies of Black dialect. It is possible to abstract from recent studies of Black dialect specific predictions concerning deviations from SAE in the present study. As Fasold and Wolfram (1970) point out, almost all the phonetic deviations from SAE associated with Negro dialect alternate with standard English forms in actual speech. Labov's studies indicate that the incidence of Black dialect features varies in the speech of individuals. Stewart (1964) refers to this quantitative variation as alternations between the acrolect (the version of the dialect closest to SAE) and the basilect (the version of the dialect furtherest from SAE). Considerable variation is evidenced within a language community as well as within individual members of the community. Therefore, the variations from SAE which are predicted on the basis of previous work in Black dialect are not expected to occur 100% of the time, but are predicted to account for a significant number of variants in the present study.

According to Stewart (discussed in Fasold, 1969) variations between basilect and acrolect are sensitive to developmental variables. Small children usually use the basilect, while youths and adults are more likely to use the acrolect.

The remainder of this section will deal with specific predictions of deviations from SAE.

2.3.1.1. Omission and devoicing of final consonants. A number of writers (see, for instance, Labov, 1970, and Fasold and Wolfram, 1970) have mentioned the tendency of Black speakers to delete the final consonant from certain types of final consonant clusters. The phonemes of the final cluster must share the same value for the feature of [voice] for this deletion to take place (Wolfram, 1970). Thus, /d/ is deleted

from 'hand', where the final cluster is voiced, but /t/ is not deleted from 'count' where the two members of the cluster do not match in voicing (i. e., /n/ is voiced and /t/ is voiceless).

Seemingly independent of the tendency to simplify final clusters is the tendency to devoice final voiced stops. This produces substitutions of /t/ for /d/, /k/ for /g/, and /p/ for /b/ in word final postion. Some writers report the frequent omission of final /d/ in words such as 'good' (i. e., where the /d/ is not part of a voiced cluster). This sort of /d/ omission is different from syntactic variation of Black English which realizes the past tense of verbs as the infinitive form. Thus, the past tense of the verb 'play' is often realized as 'play' rather than 'played.' This deletion of final /d/ is attributable to syntactic variation rather than to articulatory factors, however, and is qualitatively different from the omission of the final /d/ in 'good' or 'hand.'

According to Fasold and Wolfram (1970), final obstruents other than stops are also devoiced, but less frequently. This information leads to the prediction of word-final /s/ for /z/, /f/ for /v/, and /č/ for /ǰ/ substitutions as well.

2. 3. 1. 2. Omission of /r/ and /ℓ/. The omission of /r/ and /ℓ/ from clusters as well as from post-vocalic positions is considered by most authorities to be characteristic of Black English. Labov's (1966) discovery that this variable is greatly stratified has apparently resulted in many experts' being cautious in identifying these omissions as characteristic of Black dialect. In a recent study by Natalicio and Williams (1971) a panel of 29 language specialists listened to tapes of Black and Mexican-American children performing a standard language test. The experts responded with scaled evaluations of each child's deviation from SAE and a report of the criteria which he had used in his evaluation. In that study, while the omission of /r/ and /ℓ/ were noted by the experts as characteristic of the samples, they emphasized the possibility that the omissions could be explained on the basis of regional dialect variation or immaturity.

2. 3. 1. 3. Deviations associated with /ð/ and /θ/. The substitution of /d/ for /ð/ in initial position has been shown by Labov (1966) to be included in the speech of probably every speaker of every dialect to English. Notice that /d/ for /ð/ is a frequent substitution in the Marshalltown study (see Table 1). That study also showed that the incidence of /d/ for /ð/ substitutions decreased with age. The frequency of this substitution is considerably greater in Black English (Wolfram, 1969; Labov, 1970), however, than in most dialects of SAE. Fasold and Wolfram (1970) also report the substitution of /v/ for /ð/ in word-internal position in some dialects of black English. Labov (1970) also reports /v/ for /ð/ substitutions in word-final position. Word final /ð/ is very rare in English

however, and is not included in the Goldman Fristoe test of articulation.

It seems to be well accepted that /f/ substitutes for /θ/ in Black English, especially in medial and final positions. Wolfram (1970) claims, in fact, that this substitution represents the only invariant phonetic difference between Black English and Standard English. Other phonetic variations, such as /d/ for /ð/, are found in many or all dialects of Standard English as well as those of Black English. He claims, however, that this is not the case for the /f/ for /θ/ substitution. He notes the categorical absence of /f/ for /θ/ substitutions in middle class speech. Table 1, however, reveals that the /f/ for /θ/ substitution was quite prevalent in the Marshalltown group.

It is interesting to observe that variations in /ð/ and /θ/ were the phonological characteristics most frequently noted by the panel of experts in the Natalicio and Williams (1971) study. At the same time, the experts insisted that, given the variability of these phonemes in the overall population, their deviance was not regarded as ". . . particularly important to overall linguistic performance."

While substitutions per se have not been addressed in any one study of Black dialect, it is possible to abstract out the above predictions. For the most part, the predicted errors are not qualitatively different from those anticipated in any dialect of Standard or non-Standard English. Data gathered in the present study can be expected to test the generality of the above predictions and also to reveal any misarticulations unique to Black dialect if such qualitative deviations do in fact exist.

2.4. Published Work on Mexican-American Dialect

In 1957 Weinreich described phonic interference between a person's native language and a second language. In that paper he presented a formula for predicting phonic interference. According to his system, phonic interference occurs when the second language has phonemes in its inventory which do not occur in the native language and also when the native language has phonemes which are not present in the second language. Spanish has a much simpler phonemic system than English (Stockwell and Bowen, 1965), and there are many phonemes and phonemic distinctions which exist in English which do not exist in Spanish. Thus, it is possible to predict which English will be misarticulated by native speakers of Spanish simply by looking at the phonemic inventories of the two languages. Reed, Lado, and Shen (1948) report many of the substitution errors typically observed in Spanish-speaking informants. Some of the errors reported in that paper have been substantiated recently by Natalicio and Williams (1971). Considered next are expectations of

substitutions for speakers of English who are native speakers of Mexican Spanish.

There is neither a /θ/ nor an /ð/ in Spanish, and /s/ and /d/ are usually substituted for each, respectively. The only mellow fricatives of Spanish are /f/ and /β/. The latter is a voiced bilabial fricative which does not occur in English. Spanish does not have a distinction between /b/ and /v/, so Spanish speakers frequently confuse /b/ and /v/ in English, using /β/ for both phonemes. In certain dialects of Spanish, notably the Texas dialect around the San Antonio area, many speakers have adopted the use of /v/, usually having it in free variation with /β/. (Natalicio, personal communication).

2.4.1. Variants involving fricatives and affricates. The /s/ phoneme is the only strident fricative in Spanish; /z/, /ž/, and /š/ are absent. /č/ is the only affricate, as Spanish does not have /ǰ/. The foregoing results in /s/ being substituted frequently for /z/. The behavior of /š/ is a bit more complicated. /č/ is frequently substituted for /š/, but in addition, /č/ is frequently misarticulated as /š/. This indicates that the Mexican-American speaker perceives the English distinction between /č/ and /š/ but is unable to use it correctly. The phonemes /ž/ and /ǰ/ (both non-occurring in Spanish) and /y/ (which does occur in Spanish) are frequently confused in articulation. Reed, Lado and Shen (1948) suggest that /ž/ may be substituted for medial /ǰ/, and /y/ for initial /ǰ/, but there is apparently some question about the generality of this observation.

As was noted above, /b/ and /v/ are often confused with each other. They may substitute for each other or they may each be replaced by /β/.

2.4.2. Variants involving stops. Word initial voiceless stops are aspirated in English, but not in Spanish. The failure of native Spanish speakers to aspirate initial stops frequently results in the perception of the stop as voiced by native speakers of English. Thus, according to Natalicio and Williams (1971), ". . . 'coat,' which in SAE is [k^hot], may be produced by the Mexican-American as [kot] but perceived by SAE speakers as /got/, 'goat.'"

2.4.3. Variants involving glides. The phoneme /h/ does not occur in Spanish, but the voiceless velar fricative /x/ does occur. The Spanish speaker sometimes omits the English /h/ and sometimes replaces it with an /x/.

2.4.4. Variants involving /r/ and /ℓ/. The liquids of Spanish are articulated differently from those of English. The MAE speaker frequently produces a trilled or flapped /r/ for the SAE /r/. In the present study,

however, variations in types of liquids were not recorded and described. Omissions of liquids and substitutions by other phonemes (such as /w/) were, however, noted.

There are, then, a number of widely varying sources for error predictions in the present study. Considering the differential sources of articulatory errors for the Black and Mexican-American populations, a recently reported finding of Friedlander (1965) is highly counter-intuitive. He reports the results of articulation tests performed with speakers of Black dialect, SAE, and Mexican-American dialect. The results include only the target phonemes, however -- not the realizations in the case of substitution errors. Friedlander claims that all the phonemes for which variants were produced by the SAE speakers were varied by the Black and Mexican-American speakers. In turn, all those for which variants were produced by the Black speakers were also varied by the Mexican-American children. (He excepts medial /t/ from this generalization, meaning, presumably that the Black speakers produced variants of medial /t/ but the Mexican-Americans did not.) Replication of this finding would mean that there are no variants unique to Black dialect. It was hoped, however, that the present study would reveal a common pool of errors and unique groups of errors attributable to Black and Mexican-American speakers, respectively.

SECTION 3

DATA COLLECTION AND INITIAL TABULATION

3.1. National Speech and Hearing Survey Data Collection

During the school year 1968-1969 the National Speech and Hearing survey (NSHS) obtained speech samples from 38,802 United States school children. NSHS is based at Colorado State University, under the direction of Dr. Forrest Hull. The sample of 38,802 was drawn from the 41, 088, 138 member population of United States school children (1968-69 census). Samples were obtained from 100 school districts in 9 census divisions. A minimum sample of 384 children was tested from each district, evenly divided among grades 1-12, with the sample from each grade equally divided by sex.

The speech sample obtained from each child consisted of the Goldman-Fristoe Test of Articulation, a few minutes of connected discourse, selected speech sounds elicited in a vowel context, and the repetition of a set of four sentences. The present study utilized the first two of these speech samples. Segments of connected discourse (Free Speech) were elicited in various ways, depending on the age level of the subject. Children in grades 1-3 were given the Goldman-Fristoe Sounds in Sentences Test; children in grades 4-9 were asked to make up stories in response to pictures; children in the upper grades were asked standardized questions to stimulate free speech. The testing of subjects was done in specially equipped soundproof vans by trained NSHS staff members. All speech samples were tape recorded.

3.2. Procedure for the present Study

3.2.1. The samples. For the present study the researchers obtained speech samples from Black and Mexican-American school children. The Black sample was comprised of all speech samples obtained from grades 1-6 in Niagara Falls, New York. The Mexican-American sample consisted of all samples from an elementary school in San Antonio, Texas. Each grade sample contained 32 children.

3.2.2. Coding and tabulation of variants. The Free Speech sample for each subject was transcribed into English orthography by typists. Phonetic coders then listened to the Goldman-Fristoe test and to each subject's Free Speech sample. Variations from SAE articulation

were noted for each subject (on a "coding sheet") as either a substitution, an omission, or a distortion. In the case of substitutions, the phonetic realization of the target phoneme was noted.

In the Free Speech samples the number of occurrences of each target phoneme was recorded, as well as the number of variants produced for each. This was necessary in order to obtain a relative frequency figure for variants occurring in Free Speech. If the realization of a target phoneme was a variant of SAE on the Goldman-Fristoe test, but the target did not occur in the Free Speech sample, a notation of N/O (no occurrence) was used. If the target phoneme occurred in free speech in Standard English form, the notation N/V (no variation) was coded in the free speech column of the coding sheet. Table 2 is a sample coding sheet. The subject reported on Table 2, for instance, produced a /b/ for /p/ substitution in initial position on the Goldman-Fristoe test, but there was subsequently no occurrence of an initial /p/ in the Free Speech of Subject #153. Another variant in this subject's Goldman-Fristoe sample was the substitution of /f/ for /θ/ in medial position. All occurrences of medial /θ/ in her Free Speech, however, were realized as /θ/, thus the N/V notation appears in the Free Speech column for medial /θ/.

3.3. Two Excluded Phonemes

With two exceptions all the phonemes and clusters tested by the Goldman-Fristoe Test were evaluated in the error analysis. The excluded phonemes were /wh/ and /ŋ/. The substitution of /w/ for /wh/ is without exception the variant associated with the /wh/ phoneme. This substitution is not correlated with articulatory disorders, and is extremely common in English. Many linguists feel that the distinction between /w/ and /wh/ is dying in English, since it carries a very low functional load. That is, there are very few minimal pairs utilizing this distinction (e.g. 'wail'/'whale') and those usually involve words which are different parts of speech. Therefore, the distinction almost never affects the meaning of a word embedded in an English sentence. It was decided that the inclusion of /w/ for /wh/ substitutions would distort the data and magnify the number of variants inappropriately.

The /n/ for /ŋ/ substitution was left out of consideration because its distributional characteristics differ from any other phoneme in the language. /ŋ/ patterns more like a cluster than like an individual phoneme, e.g. it usually occurs only in word-final position. When it is not in word-final position it is in stem-final position at a morpheme boundary (e.g. 'sing'/'singer', where there is obviously a morpheme boundary after the /ŋ/ in 'singer'.) In 'finger', where there is no evidence for a morpheme boundary following the /ng/ cluster, the intervocalic /ŋ/ is disallowed by the rules of English. Of course, /ŋ/ frequently occurs in

Table 2

Sample Coding Sheet

Subject # 153 Sex F Grade 4 City Niagara Falls

G. F.			F. S.				
Position	Variant	f	Position	# of occurrences of target	# of variants	Variants	# of occurrences of each variant
ð			ð				
f	ø*	2	f	11	7	ø	7
d			d				
f	t	1	f	4	3	t	2
						ø	1
p			p				
i	b	1	N/O				
θ			θ				
m	f	1	N/V				
f	f	1	f	2	1	t	1

*An omission is indicated by the null sign, 'ø'.

clusters before a /k/ or a /g/, usually as a positional variant of /n/ (e.g. 'congress'/'congressional', where stress is one of the determining characteristics of the assimilation). The distribution of /ŋ/ is similar to the distribution of the clusters /mb/ and /nd/ in that none of these three may occur in word-initial position. Thus, to have treated /ŋ/ like any other phoneme, especially like any other nasal phoneme, would have been highly misleading at best. Therefore, if it had been analyzed, it should have been treated as a cluster. However, the only clusters treated were those occurring in word-initial position. Hence, /ŋ/ could not have been treated on that basis. Adding to the difficulty with /ŋ/ is the fact that the vast majority of /ŋ/ errors occur as an /n/ for /ŋ/ substitution associated with the 'ing' morpheme in progressive and gerundive constructions. The /ŋ/ occurring in the 'ing' morpheme and the /ŋ/ discussed above (which behaves as a stem-final cluster) are phonologically very different. To have collapsed the two types of /ŋ/ as one phoneme for analysis would have simply added to the confusion.

SECTION 4

RESULTS

In this section the quantitative results of the present study will be reported; the discussion of the linguistic and sociolinguistic implications of the data will be reserved for Section 5. These quantitative results consist of tabulations -- for each subject -- of the articulatory variants which were produced under two speech conditions, responses to the Goldman-Fristoe Test of Articulation and brief segments of connected discourse (Free Speech). The results are reported in this section in the following order:

(1) First reported are the frequency and type of variants for each grade and for each target phoneme. The type of variant (omission, distortion or substitution) is noted, and, in the case of substitutions, the substituted phonemes are noted.

(2) In order to investigate trends across grades, several statistical tests are reported and the trends graphically represented. These trends are interpreted relative to a primary goal of discovering which variants from SAE are attributable to dialect differences and which are attributable to developmental factors. It is expected that dialect variants will remain at a fairly stable level across grades, while those variants which disappear at the higher grade levels will be attributable to developmental factors. All reports of trends across grades and all statistical tests were carried out on Goldman-Fristoe data only, because the Goldman-Fristoe test provides a speech corpus which is identical for each subject. It is well known that free speech samples typically suffer from the problem of differential frequency of occurrence of various phonemes within and between subjects. Thus all statistical analyses were carried out on Goldman-Fristoe data. The role of the Free Speech data is discussed below.

(3) The stability of variants across the two speech modes, Goldman-Fristoe test and Free Speech, were assessed by a direct comparison of the subjects' performance across the two samples. Only the most frequent variants are subjected to this comparison.

(4) Adding across grades, the most frequent variants found in the Goldman-Fristoe data are presented separately, together with the linguistic feature data for each. This presentation, together with the data showing trends across grades, provides the basis for a discussion (in Section 5) of the linguistic and sociolinguistic significance of the present results.

All the above presentations are given separately for each dialect group, first for the Niagara Falls group, then for the San Antonio. No comparisons of the two groups are made in this section, but Section 5 incorporates a discussion of the implications of similarities and differences among the two groups.

4. 1. Niagara Falls: The Black Sample

4. 1. 1. Raw data presentation. Tables 3 and 4 report the raw data for the Niagara Falls children. Specifically Table 3 presents all phonetic variation recorded on the Goldman-Fristoe Test of Articulation, while Table 4 reports similar data from the Free Speech samples of the children. The rows of both these tables are target phonemes (and blends); the columns are grades (1-6). Each cell reports the number of variants of the row phoneme recorded for the row grade, the number of children who produced a variant, and the relative frequency of error for that target phoneme. The relative frequency figure reflects the frequency of variation of a target phoneme vis á vis the frequency of occurrence of that target phoneme among the subjects producing variations.[1] Each cell of Tables 3 and 4 also contains an enumeration of the types of variations observed and the frequency of occurrence of each. In the case of substitutions, the substituted phoneme is noted; distortions are represented as 'dist'; and omissions are indicated by the null sign, Ø.

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[1] On both tables the number of occurrences of the target phonemes are indicated. The relative frequency of error is computed by dividing the number of variants by the number of occurrences of the target. In the case of the Free Speech table, the number of occurrences was determined by counting the tokens of each phoneme on which an error was made. In the case of the Goldman-Fristoe test, occurrences for each subject was constant, since the language sample was the same for all subjects. Thus, the occurrence value for each target was obtained by multiplying the number of occurrences of that target in the Goldman-Fristoe by the number of children who produced a variant of that phoneme on the Goldman-Fristoe test. The number of occurrences of each target phoneme on the Goldman-Fristoe is noted in parentheses to the left of the position indicator for target symbol on Table 3. Appendix B lists the words in which each target appears.

To illustrate this procedure, note for instance /č/ in initial position in first grade on Table 3. There are two occurrences of initial /č/ on the Goldman-Fristoe test (in chicken and church -- cf. Appendix B). Five subjects produced variants of initial /č/ in the first grade on Niagara Falls, therefore ten occurrences of initial /č/ are represented in this cell. There are five variants noted in the cell. The division of the number of variants (five) by the number of occurrences of the target (ten) produces a relative frequency of .50. The analagous cell of Table 4 (initial /č/, first grade, Niagara Falls) reveals that two subjects produced two occurrences of the target in Free Speech and produced variants on both occasions. Therefore, the relative frequency noted in that cell in 1.0.

Table 3

Variants Produced by Speakers of BE on the Goldman-Fristoe Test of Articulation*

Target		Grade 1			2			3			4			5			6			Total Variants		
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		9	12	.33	10	15	.38	5	6	.30	1	1	.25	4	4	.25	3	4	.33	32	42	.33
	(4)m	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
ɹ		Ø	12		Ø	15		Ø	6		Ø	1		Ø	4		Ø	4		Ø	42	
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		10	15	.30	16	27	.34	17	35	.41	16	34	.40	22	50	.45	22	48	.44	103	209	.41
	(5)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
		Ø	15		Ø	27		Ø	35		Ø	34		Ø	50		Ø	48		Ø	209	
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		0			1	1	.33	0			0			0			0			1	1	.33
	(3)i				variants	f														variants	f	
b					t	1														t	1	

Table 3 (cont'd)

		Grade																	Total Variants		
		1			2			3			4			5			6					
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		6	6	1	14	14	1	11	11	1	11	11	1	19	19	1	17	17	1	78	78	1
b	(1)f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
			p	3		p	7		Ø	6		Ø	7		p	17		p	15		p	51
			Ø	2		Ø	7		p	5		p	4		Ø	2		Ø	2		Ø	26
			g	1																	g	1
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		5	5	.50	1	1	.50	4	5	.63		0		3	3	.50	1	1	.50	14	15	.54
	(2)i	variants		f	variants		f	variants		f				variants		f	variants		f	variants		f
			t	3		t	1		t	3					t	3		š	1		t	10
č			š	1					š	1											š	3
			Ø	1					s	1											s	1
																					Ø	1

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	4	4	1	1	1	1	2	2	1		0		2	2	1		0		9	9	1
(1)m	variants		f	variants		f	variants		f				variants		f				variants		f
		Ø	2		ǰ	1		t	1					t	2					t	4
		z	1					š	1											Ø	2
		t	1																	z	1
																				š	1
																				ǰ	1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	4	4	1	1	1	1	3	3	1		0		4	4	1		0		12	12	1
(1)f	variants		f	variants		f	variants		f				variants		f				variants		f
		š	1		Ø	1		t	2					t	2					t	5
		s	1					?	1					Ø	1					Ø	3
		t	1											dist	1					s	1
		Ø	1																	š	1
																				dist	1
																				?	1

Table 3 (cont'd)

Target	Grade 1			2			3			4			5			6			Total Variants		
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	1	1	1	1		0			0			0			0		2	2	1
(1)m	variants		f	variants		f													variants		f
		Ø	1		Ø	1														Ø	2
d	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	11	11	1	17	17	1	12	12	1	14	14	1	19	19	1	22	22	1	95	95	1.0
(1)f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
		Ø	5		t	14		t	7		t	13		t	15		t	20		t	75
		t	6		Ø	2		Ø	5		Ø	1		Ø	1		?	1		Ø	15
					s	1								?	3		Ø	1		?	4
																				s	1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	2	2	.33		0			0			0			0			0		2	2	.33
(3)i	variants		f																variants		f
		t	1																	t	1
f		p	1																	p	1

Table 3 (cont'd)

Target		Grade 1			2			3			4			5			6			Total Variants		
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		1	1	1	2	2	1	2	2	1	3	3	1	1	1	1		0		9	9	1
f	(1)f	variants		f	variants		f	variants		f	variants		f	variants		f				variants		f
			Ø	1		s	1		Ø	2		Ø	2		s	1					Ø		6
						Ø	1					s	1								s		3
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		1	1	1		0			0			0		1	1	1		0		2	2	1
	(1)i	variants		f										variants		f				variants		f
			d	1											d	1					d		2
g		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		2	2	1		0			0			0			0			0		2	2	1
	(1)m	variants		f																variants		f
			d	2																	d		2

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	7	7	1	10	10	1	7	7	1	5	5	1	13	13	1	10	10	1	52	52	1
g (1)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
	k	5		k	6		k	6		Ø	4		k	8		k	9		k		35
	Ø	2		Ø	4		Ø	1		k	1		Ø	3		Ø	1		Ø		15
													?	2					?		2
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	1	2	2	1		0			0		1	1	1		0		4	4	1
(1)i	variants	f		variants	f								variants	f					variants		f
	s	1		d	2								d	1					d		3
																			s		1
j	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	2	2	1	1	1	1	1	1	1		0		1	1	1		0		5	5	1
(1)m	variants	f		variants	f		variants	f					variants	f					variants		f
	y	1		g	1		č	1					d	1					y		1
	Ø	1																	Ø		1
																			g		1
																			č		1
																			d		1

Table 3 (cont'd)

Target		Grade																		Total Variants		
		1			2			3			4			5			6					
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		10	10	1	8	8	1	10	10	1		0		10	10	1	6	6	1	44	44	1
ǰ	(1)f	variants		f	variants		f	variants		f				variants		f	variants		f	variants		f
			č	7		č	7		č	7					č	9		č	6		č	36
			Ø	3		Ø	1		Ø	2					d	1					Ø	6
									s	1											s	1
																					d	1
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		3	5	.56	1	1	.33		0			0			0			0			4	6	.50
k	(3)i	variants		f	variants		f													variants		f
			t	4		t	1														t	5
			p	1																	p	1

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	3	3	.50	1	1	.50	7	7	.50	3	3	.50	1	1	.50		0		15	15	.50
(2)m	variants	f		variants	f		variants	f		variants	f		variants	f					variants	f	
	h	1		Ø	1		s	2		Ø	2		s	1					Ø	6	
	Ø	1					Ø	2		š	1								s	4	
	s	1					r	1											š	1	
							t	1											r	1	
							g	1											t	1	
																			g	1	
																			h	1	
k																					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	2	2	1	1	1	1		0		3	3	1	1	1	1		0		7	7	1
(1)f	variants	f		variants	f					variants	f		variants	f					variants	f	
	t	1		p	1					Ø	2		?	1					Ø	3	
	Ø	1								?	1								?	2	
																			t	1	
																			p	1	

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	2	2	1		0			0			0		2	2	1		0		4	4	1
(1)i	variants	f											variants	f					variants	f	
	y	1											w	2					w	3	
	w	1																	y	1	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	6	6	.50	1	1	.50	3	3	.50	1	1	.50		0			0		11	11	.50
ℓ (2)m	variants	f		variants	f		variants	f		variants	f								variants	f	
	Ø	5		Ø	1		Ø	2		Ø	1								Ø	9	
	d	1					r	1											d	1	
																			r	1	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	11	24	.73	13	23	.59	12	19	.53	4	9	.75	18	41	.76	11	26	.79	69	142	.69
(3)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	Ø	24		Ø	23		Ø	19		Ø	7		Ø	41		Ø	26		Ø	140	
										w	2								w	2	

Table 3 (cont'd)

Target	Grade 1			2			3			4			5			6			Total Variants		
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	1		0			0			0			0			0		1	1	1
(1)i	variants		f																variants		f
		r	1																	r	1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	.50		0		2	2	.50		0			0			0		3	3	.50
(2)m	variants		f				variants		f										variants		f
		Ø	1					Ø	1											Ø	2
m								?	1											?	1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	5	8	.53	5	5	.33	3	3	.33	1	1	.33	1	1	.33	1	1	.33	16	19	.40
(3)f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
		Ø	7		Ø	4		Ø	3		n	1		Ø	1		Ø	1		Ø	16
		p	1		p	1														p	2
																				n	1

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		0			0		1	1	1		0			0			0		1	1	1
(1)i							variants		f										variants		f
								ℓ	1											ℓ	1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	8	11	.28	6	7	.23	6	6	.20		0		4	4	.20	4	4	.20	28	32	.23
(5)m	variants		f	variants		f	variants		f				variants		f	variants		f	variants		f
		Ø	9		Ø	7		Ø	5					Ø	3		Ø	3		Ø	27
n		k	1					ℓ	1					t	1		t	1		t	2
		?	1																	k	1
																				?	1
																				ℓ	1

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	11	25	.45	17	29	.34	14	20	.29	2	4	.40	13	25	.38	12	17	.28	69	120	.34
n (5)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	Ø	24		Ø	28		Ø	18		Ø	4		Ø	17		Ø	14		Ø	105	
	?	1		m	1		?	2					?	8		?	3		?	14	
																			m	1	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	5	5	1	7	7	1	7	7	1	10	10	1	8	8	1	4	4	1	41	41	1
(1)i	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	b	4		b	7		b	7		b	10		b	8		b	4		b	40	
	Ø	1																	Ø	1	
p	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	.33	1	1	.33	1	1	.33	1	1	.33	1	1	.33		0		5	5	.33
(3)m	variants	f		variants	f		variants	f		variants	f		variants	f					variants	f	
	f	1		Ø	1		?	1		Ø	1		b	1					Ø	2	
																			b	1	
																			f	1	
																			?	1	

Table 3 (cont'd)

Target		Grade 1			Grade 2			Grade 3			Grade 4			Grade 5			Grade 6			Total Variants		
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		5	6	.60	7	7	.50	7	7	.50	4	4	.50	3	3	.50	2	2	.50	28	29	.52
p	(2)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
		Ø	6		Ø	6		Ø	5		Ø	3		Ø	3		Ø	2		Ø	25	
					?	1		f	1		f	1								f	2	
								?	1											?	2	
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		4	5	.63	5	9	.90	4	4	.50		0		6	6	.50	4	5	.63	23	29	.63
	(2)i	variants	f		variants	f		variants	f					variants	f		variants	f		variants	f	
		w	4		w	9		w	4					w	6		w	5		w	28	
		g	1																	g	1	
r		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		8	9	.56	9	10	.55	7	7	.50		0		8	9	.56	4	4	.50	36	39	.54
	(2)m	variants	f		variants	f		variants	f					variants	f		variants	f		variants	f	
		w	5		w	10		w	5					w	7		w	4		w	31	
		Ø	3					Ø	1					Ø	2					Ø	6	
		?	1					b	1											b	1	
																				?	1	

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		0		2	2	.50		0			0		1	1	.50		0		3	3	.50
(2)i				variants	f								variants	f					variants	f	
				dist	1								θ	1					dist	1	
				š	1														š	1	
																			θ	1	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	.50		0		1	1	.50		0		1	1	.50		0		3	3	.50
s (2)m	variants	f					variants	f					variants	f					variants	f	
	Ø	1					dist	1					Ø	1					Ø	2	
																			dist	1	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	4	5	.63	4	4	.50	9	9	.50	4	5	.63	2	2	.50	1	1	.50	24	26	.54
(2)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	Ø	5		Ø	4		Ø	8		Ø	5		Ø	2		Ø	1		Ø	25	
							θ	1											θ	1	

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	2	2	1	3	3	1	2	2	1	1	1	1	2	2	1	1	1	1	11	11	1
(1)i	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
	s	1		dist	1		s	1		s	1		č	1		č	1		č		5
	č	1		č	2		dist	1					s	1					s		4
																			dist		2
š	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	3	3	1		0		2	2	1		0		3	3	1		0		8	8	1
(1)m	variants	f					variants	f					variants	f					variants		f
	s	1					s	2					č	2					č		3
	∅	1											dist	1					s		3
	č	1																	∅		1
																			dist		1

Table 3 (cont'd)

Target		Grade 1			2			3			4			5			6			Total Variants		
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		3	3	1		0		2	2	1		0		3	3	1		0		8	8	1
š	(1)f	variants	f					variants	f					variants	f					variants	f	
		s	1					s	1					č	2					č	3	
		Ø	1					dist	1					dist	1					s	2	
		č	1																	dist	2	
																				Ø	1	
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		1	1	.50		0			0		3	3	.50		0			0		4	4	.50
	(2)m	variants	f								variants	f								variants	f	
		Ø	1								Ø	3								Ø	4	
t		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		4	4	.50	5	5	.50	4	4	.50	1	1	.50	4	5	.63	4	4	.50	22	23	.52
	(2)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
		Ø	3		Ø	3		Ø	2		Ø	1		Ø	4		Ø	3		Ø	16	
		?	1		?	2		?	2					?	1		?	1		?	7	

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	9	9	1	9	9	1	9	9	1	5	6	1	2	2	1	2	2	1	37	37	1
(1)i	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
	t	4		f	5		f	6		f	5		t	2		t	2		f		18
	d	3		t	3		t	3		d	1								t		14
	f	2		d	1														d		5
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	12	12	1	18	18	1	28	28	1	27	27	1	22	22	1	19	19	1	126	126	1
(1)m	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
	f	11		f	9		f	21		Ø	5		f	20		t	2		f		98
	Ø	1		Ø	6		Ø	6		ʒ	1		Ø	2		Ø	1		Ø		21
				s	2		?	1		f	21					f	16		t		3
				t	1														s		2
																			?		1
																			ʒ		1

θ

07

Table 3 (cont'd)

Target		Grade 1			2			3			4			5			6			Total Variants		
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		17	17	1	18	18	1	25	25	1	22	22	1	18	18	1	10	10	1	110	110	1
	(1)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
θ		f	15		f	16		f	20		f	19		t	1		t	1		f		96
		Ø	2		Ø	2		Ø	5		t	1		f	17		f	9		Ø		11
											Ø	2								t		3
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		15	15	1	14	14	1	20	20	1	17	17	1	23	23	1	18	18	1	107	107	1
	(1)i	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
		d	15		d	14		d	20		d	17		d	23		d	17		d		106
																	Ø	1		Ø		1
ϑ		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		3	3	1	2	2	1	2	2	1		0			0			0		7	7	1
	(1)m	variants	f		variants	f		variants	f											variants		f
		d	2		d	2		d	1											d		5
		ℓ						z	1											ℓ		1
																				z		1

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	8	8	1	9	9	1	18	18	1	16	16	1	7	7	1	5	5	1	63	63	1
(1)i	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
		b	7		b	9		b	15		b	16		b	6		b	5		b	58
		w	1					w	1					ℓ	1					w	2
								f	1											f	1
								m	1											m	1
																				ℓ	1
v	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	8	8	1	2	2	1	1	1	1	2	2	1	2	2	1		0		15	15	1
(1)m	variants		f	variants		f	variants		f	variants		f	variants		f				variants		f
		b	8		b	1		b	1		b	1		b	2					b	13
					w	1					Ø	1								w	1
																				Ø	1

Table 3 (cont'd)

Target	Grade 1			2			3			4			5			6			Total Variants		
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	1	5	5	1	4	4	1	6	6	1	8	8	1	4	4	1	28	28	1
v (1)f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
		b	1		Ø	3		Ø	3		Ø	5		Ø	4		Ø	2		Ø	17
					b	1		f	1		b	1		f	4		f	2		f	7
					w	1														b	3
																				w	1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		0			0			0			0			0		1	1	1	1	1	1
w (1)i																variants		f	variants		f
																	Ø	1		Ø	1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	1		0			0			0			0			0		1	1	1
y (1)i	variants		f																variants		f
		z	1																	z	1

Table 3 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	3	3	1	3	3	1	3	3	1	1	1	1	5	5	1	4	4	1	19	19	1
(1)i	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
	s	2		s	3		s	2		s	1		s	4		s	3		s		15
	f	1					š	1					d	1		š	1		š		1
																			d		1
																			f		1
																			ǰ		1
z																					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	2	2	1		0			0			0		1	1	1	1	1	1	4	4	1
(1)m	variants	f											variants	f		variants	f		variants		f
	dist	1											d	1		dist	1		dist		2
	s	1																	d		1
																			s		1

Table 3 (cont'd)

Target	Grade 1			Grade 2			Grade 3			Grade 4			Grade 5			Grade 6			Total Variants		
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	5	10	.50	6	7	.29	7	7	.25	2	2	.25	4	5	.31	6	8	.33	38	39	.25
z (4)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	Ø	7		Ø	5		Ø	5		Ø	2		Ø	2		s	6		s	15	
	s	3		s	2		s	1					s	3		Ø	2		Ø	23	
							dist	1											dist	1	
	n	f		n	f		n	f		n	f		n	f		n	f		n	f	
	0			1	1		0			0			0			1	1		2	2	
b				variants	f											variants	f		variants	f	
				g	1											p	1		g	1	
																			p	1	
br																					
	n	f		n	f		n	f		n	f		n	f		n	f		n	f	
	2	2		2	2		1	1		0			2	2		2	2		9	9	
r	variants	f		variants	f		variants	f					variants	f		variants	f		variants	f	
	Ø	2		Ø	1		w	1					w	2		w	2		Ø	3	
				w	1														w	6	

Table 3 (cont'd)

Target		Grade 1		2		3		4		5		6		Total Variants	
		n	f	n	f	n	f	n	f	n	f	n	f	n	f
		1	1	0		0		0		0		0		1	1
bℓ	ℓ	variants	f											variants	f
		Ø	1											Ø	1
		n	f	n	f	n	f	n	f	n	f	n	f	n	f
		0		1	1	1	1	0		2	2	1	1	5	5
	d			variants	f	variants	f			variants	f	variants	f	variants	f
				g	1	g	1			g	1	ǰ	1	g	3
										Ø	1			Ø	1
														j	1
dr		n	f	n	f	n	f	n	f	n	f	n	f	n	f
		4	4	2	2	1	1	0		3	3	4	4	14	14
	r	variants	f	variants	f	variants	f			variants	f	variants	f	variants	f
		w	2	w	2	w	1			w	2	w	3	Ø	2
		Ø	1							y	1	Ø	1	w	10
		y	1											y	2

Table 3 (cont'd)

Target		Grade 1	2	3	4	5	6	Total Variants
		n f	n f	n f	n f	n f	n f	n f
		3 3	0	0	0	0	0	3 3
	f	variants f						variants f
		v 1						v 1
		b 1						b 1
:		p 1						p 1
fℓ		n f	n f	n f	n f	n f	n f	n f
		1 1	2 2	2 2	0	0	0	5 5
	ℓ	variants f	variants f	variants f				variants f
		∅ 1	∅ 1	∅ 1				∅ 3
			r 1	r 1				r 2
		n f	n f	n f	n f	n f	n f	n f
		1 1	0	0	0	0	0	1 1
gr	r	variants f						variants f
		w 1						w 1

Table 3 (cont'd)

Target		Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6		Total Variants	
		n	f	n	f	n	f	n	f	n	f	n	f	n	f
		1	1	1	1	1	1	0		0		0		3	3
	k	variants	f	variants	f	variants	f							variants	f
		t	1	t	1	t	1							t	3
kr		n	f	n	f	n	f	n	f	n	f	n	f	n	f
		5	5	6	6	3	3	1	1	2	2	2	2	19	19
	r	variants	f	variants	f	variants	f	variants	f	variants	f	variants	f	variants	f
		∅	4	∅	4	∅	2	∅	1	w	1	w	1	∅	13
		w	1	w	2	w	1			∅	1	∅	1	w	6
		n	f	n	f	n	f	n	f	n	f	n	f	n	f
		3	3	0		0		0		0		0		3	3
	k	variants	f											variants	f
kl		t	2											t	2
		∅	1											∅	1

Table 3 (cont'd)

Target	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Total Variants
	n f	n f	n f	n f	n f	n f	n f
	3 3	3 3	0	1 1	1 1	1 1	9 9
kℓ							
ℓ	variants f	variants f		variants f	variants f	variants f	variants f
	Ø 3	Ø 3		Ø 1	w 1	Ø 1	Ø 8
							w 1
	n f	n f	n f	n f	n f	n f	n f
	0	0	1 1	0	0	0	1 1
p			variants f				variants f
			f 1				f 1
pℓ							
	n f	n f	n f	n f	n f	n f	n f
	0	0	1 1	1 1	1 1	0	3 3
ℓ			variants f	variants f	variants f		variants f
			w 1	w 1	w 1		w 3

Table 3 (cont'd)

Target	Grade 1	2	3	4	5	6	Total Variants
	n f	n f	n f	n f	n f	n f	n f
	1 1	0	0	0	0	0	1 1
s	variants f						variants f
	Ø 1						Ø 1
	n f	n f	n f	n f	n f	n f	n f
	2 2	1 1	1 1	0	0	0	4 4
k	variants f	variants f	variants f				variants f
skw	t 1	t 1	Ø 1				Ø 1
	f 1						f 1
							t 2
	n f	n f	n f	n f	n f	n f	n f
	4 4	7 7	8 8	1 1	2 2	1 1	23 23
w	variants f	variants f	variants f	variants f	variants f	variants f	variants f
	Ø 4	Ø 7	Ø 8	Ø 1	Ø 2	Ø 1	Ø 23

Table 3 (cont'd)

Target	Grade												Total Variants	
	1		2		3		4		5		6			
	n	f	n	f	n	f	n	f	n	f	n	f	n	f
	1	1	0		0		1	1	0		0		2	2
s	variants	f					variants	f					variants	f
	t	1					š	1					š	1
													t	1
sℓ	n	f	n	f	n	f	n	f	n	f	n	f	n	f
	2	2	1	1	0		0		2	2	0		5	5
ℓ	variants	f	variants	f					variants	f			variants	f
	v	1	∅	1					w	2			∅	2
	∅	1											v	1
													w	2

Table 3 (cont'd)

Target		Grade 1		2		3		4		5		6		Total Variants	
		n	f	n	f	n	f	n	f	n	f	n	f	n	f
		1	1	3	3	1	1	0		2	2	0		7	7
tr	r	variants	f	variants	f	variants	f			variants	f			variants	f
		w	1	w	3	w	1			w	2			w	7
Total		342		334		339		218		357		261	=	1851	
Omissions		169		170		154		96		147		117	=	853	
Substitutions		172		162		181		122		207		143	=	987	
Distortions		1		2		4		0		3		1	=	11	

*For each cell entry, n is the number of subjects who produced a variant for the row phoneme in the column grade; f is the number of variants produced; rf indicates the relative frequency of the total variants for each target (see Footnote 1, this section, for a detailed discussion of the rf figure.) The number of occurrences of each target on the Goldman-Fristoe test is indicated by the numeral to the left of that target's position indicator (i, m, or f). Each cell entry the observed variants are listed, with the number of occurrences of each. Omissions are indicated by the null sign, Ø.

Table 4

Variants Occurring in the Free Speech of Speakers of Black English*

Target		Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		7	8	13	.62	15	33	95	.35	6	10	39	.26	5	19	40	.48	9	32	50	.64	9	24	40	.60	51	126	277	.45
	m	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
		Ø		8		Ø		33		Ø s		9 1		Ø		19		Ø		32		Ø		24		Ø s		125 1	
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		14	76	149	.51	25	186	322	.58	17	132	188	.70	23	191	296	.65	26	142	243	.58	26	117	214	.55	131	844	1412	.60
	f	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
		Ø		76		Ø		186		Ø		132		Ø		191		Ø		142		Ø		117		Ø		844	
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		1	1	13	.08	1	2	12	.17	1	1	1	1		0				0				0			3	4	26	.15
	i	variants		f		variants		f		variants		f														variants		f	
b		w		1		Ø h		1 1		p		1														Ø h p w		1 1 1 1	

Table 4 (cont'd)

Target	Grade 1				2				3				4				5				6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1			0		2	2	4	.50			0				0				0		3	3	5	.60
m	variants			f					variants			f													variants			f
	Ø			1					w			2													Ø			1
																									w			2
b	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	2	3	3	1	6	7	9	.78	3	8	10	.80			0		1	1	1	1			0		12	19	23	.83
f	variants			f	variants			f	variants			f					variants			f					variants			f
	p			2	Ø			4	Ø			5					p			1					Ø			10
	Ø			1	p			2	p			2													p			7
					?			1	z			1													z			1
																									?			1
č i	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	2	2	2	1			0				0				0				0				0		2	2	2	1
	variants			f																					variants			f
	t			1																					t			1
	š			1																					š			1

Table 4 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
			0		2	4	4	1			0				0				0				0		2	4	4	1
m					variants			f																	variants			f
					š			4																	š			4
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
			0		2	2	6	.34	1	1	1	1			0				0				0		3	3	7	.43
f					variants			f	variants			f													variants			f
					š			1	š			1													š			2
					Ø			1																	Ø			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
			0			0			1	3	5	.60			0				0				0		1	3	5	.60
d									variants			f													variants			f
i									Ø			3													Ø			3

Table 4 (cont'd)

Target	Grade																						Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	2	3	8	.38	6	10	37	.27	3	3	12	.25	3	5	11	.45	12	15	29	.52	5	6	12	.50	31	42	109	.38
m	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	Ø			2	Ø			8	Ø			1	Ø			2	Ø			13	Ø			4	Ø			30
	?			1	t			1	?			2	?			2	t			1	t			2	t			5
					?			1					t			1	?			1					?			7
d																												
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	12	36	69	.52	23	89	144	.62	20	70	132	.53	18	73	116	.63	20	53	82	.65	21	48	67	.72	114	369	610	.60
f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	Ø			30	Ø			61	Ø			36	t			39	t			23	t			20	Ø			188
	t			5	t			21	t			22	Ø			21	Ø			20	Ø			20	t			130
	?			1	?			7	?			12	?			13	?			10	?			6	?			51
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	3	8	.38	0				0				0				0				0				1	3	8	.38
i																									variants			f
f	variants			f																								
	p			3																					p			3

Table 4 (cont'd)

Target	Grade 1				2				3				4				5				6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
			0		3	3	7	.43			0				0				0				0		3	3	7	.43
f f					variants			f																	variants			f
					Ø			2																	Ø			2
					s			1																	s			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1		0				0				0			1	1	2	.50		0			2	2	3	.67
m	variants			f													variants			f					variants			f
	?			1													Ø			1					Ø			1
																									?			1
g	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	2	2	2	2	8	8	15	.53	7	9	10	.90	3	4	4	1	3	4	4	1	4	5	6	.83	27	32	41	.78
f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	k			2	k			5	k			5	Ø			2	k			3	k			4	Ø			11
					Ø			3	Ø			4	k			2	Ø			1	Ø			1	k			21

Table 4 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	3	6	7	.86	2	2	3	.66			0		1	4	5	.80			0				0		6	12	15	.80
i	variants			f	variants			f					variants			f									variants			f
	d			5	d			2					d			4									Ø			1
	Ø			1																					d			11
j																												
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	3	3	3	1	3	3	3	1	1	2	20	.10			0		2	3	3	1			0		9	11	29	.38
f	variants			f	variants			f	variants			f					variants			f					variants			f
	Ø			2	d			1	č			2					š			2					Ø			4
	č			1	ž			1									Ø			1					č			3
					Ø			1																	d			1
																									š			2
																									ž			1
k	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	2	2	1		0				0				0				0				0			1	2	2	1
i	variants			f																					variants			f
	t			2																					t			2

Table 4 (cont'd)

Target	Grade 1				2				3				4				5				6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1	1	1	4	.25			0		1	1	10	.10	1	1	6	.17			0		4	4	21	.19
m	variants			f	variants			f					variants			f	variants			f					variants			f
	t			1	Ø			1					Ø			1	?			1					Ø			2
																									t			1
																									?			1
k	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	4	4	13	.31	5	5	27	.19	3	3	17	.18	1	1	21	.05	3	3	12	.25	4	6	18	.33	20	22	108	.20
f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	Ø			4	Ø			3	Ø			2	Ø			1	?			2	Ø			6	Ø			17
					t			1	t			1					Ø			1					g			1
					g			1																	t			2
																									?			2
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				0				1	1	2	.50	0				0				0				1	1	2	.50
i									variants			f													variants			f
ℓ									v			1													v			1

Table 4 (cont'd)

Target		Grade 1				2				3				4				5				6				Total Variants			
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		6	7	27	.26	8	15	50	.30	5	6	22	.27	3	6	33	.18	2	5	10	.50	7	11	26	.42	31	50	168	.30
	m	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
		Ø d y w			4 1 1 1	Ø			15	Ø			6	Ø d			4 2	Ø			5	Ø			11	Ø d w y			45 3 1 1
l		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		9	28	41	.68	17	46	91	.51	20	44	97	.45	4	16	21	.76	16	46	73	.63	11	21	39	.54	77	201	362	.56
	f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
		Ø			28	Ø			46	Ø w			43 1	Ø			16	Ø			46	Ø			21	Ø w			200 1
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
						1	1	7	.14	0				0				0				0				1	1	7	.14
	i					variants			f																	variants			f
	m					Ø			1																	Ø			1

Table 4 (cont'd)

Target	Grade 1				2				3				4				5				6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	4	.25	1	1	3	.33	1	2	3	.67	0				0				0				3	4	10	.40
m	variants		f		variants		f		variants		f														variants		f	
	Ø		1		Ø		1		Ø		2														Ø		4	
m	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	5	7	33	.21	5	9	30	.30	3	4	21	.19	2	2	7	.29	3	4	27	.15	3	5	19	.26	21	31	130	.24
f	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	Ø		6		Ø		7		Ø		3		Ø		2		Ø		4		Ø		5		Ø		27	
	p		1		?		2		?		1														p		1	
																									?		3	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				0				1	1	3	.33	0				0				0				1	1	3	.33
i									variants		f														variants		f	
n									Ø		1														Ø		1	

Table 4 (cont'd)

Target		Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		4	7	29	.24	6	9	50	.18	5	5	32	.16		0			4	5	20	.25	2	2	12	.17	21	28	143	.20
	m	variants		f		variants		f		variants		f						variants		f		variants		f		variants		f	
		Ø		7		Ø		9		Ø ?		4 1						Ø ?		4 1		Ø		2		Ø ?		26 2	
n		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		8	29	125	.23	17	51	353	.14	13	34	320	.11	3	5	89	.06	9	46	149	.31	7	23	135	.17	57	188	1171	.16
	f	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
		Ø		29		Ø ?		45 6		Ø ?		27 7		Ø ?		4 1		Ø ?		44 2		Ø ?		20 3		Ø ?		169 19	
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		3	3	6	.50	5	5	10	.50	4	4	10	.40		0				0				0			12	12	26	.46
	i	variants		f		variants		f		variants		f														variants		f	
p		b		3		b Ø		4 1		b		4														Ø b		1 11	

Table 4 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				2	2	3	.67	1	1	5	.20	0				0				0				3	3	8	.38
m					variants		f		variants		f														variants		f	
					?		1		b		1														Ø		1	
					Ø		1																		b		1	
																									?		1	
p	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	3	3	14	.21	4	6	17	.35	2	2	5	.50	0				0				1	2	9	.22	10	13	45	.29
f	variants		f		variants		f		variants		f										variants		f		variants		f	
	Ø		3		Ø		5		Ø		1										Ø		2		Ø		11	
					?		1		?		1														?		2	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	2	.50	5	8	14	.57	1	1	1	1	0				1	2	3	.66	3	3	5	.60	11	15	25	.60
i	variants		f		variants		f		variants		f						variants		f		variants		f		variants		f	
r	w		1		w		8		w		1						w		2		w		3		w		15	

Table 4 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				4	4	21	.19	2	2	5	.40	0				1	1	1	1	0				7	7	27	.26
r m					variants			f	variants			f					variants			f					variants			f
					w Ø			3 1	Ø			2					Ø			1					Ø w			4 3
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	12	.08	3	5	27	.19	2	7	11	.64	0				1	1	2	.50	0				7	14	52	.27
	variants			f	variants			f	variants			f					variants			f					variants			f
i	t			1	t č Ø			2 2 1	dist š Ø			3 3 1					θ			1					Ø č š t θ dist			2 2 3 3 1 3
s																												

Table 4 (cont'd)

Target		Grade 1				2				3				4				5				6				Total Variants			
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		2	3	8	.38	4	5	14	.36			0				0		1	1	6	.17			0		7	9	28	.32
m		variants		f		variants		f										variants		f						variants		f	
		dist		2		Ø		3										Ø		1						Ø		4	
		š		1		?		1																		h		1	
						h		1																		š		1	
																										?		1	
																										dist		2	
s		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		2	3	9	.33	3	6	15	.40	2	2	3	.67	2	3	13	.23	1	2	4	.50			0		10	16	44	.36
f		variants		f		variants		f		variants		f		variants		f		variants		f						variants		f	
		Ø		3		Ø		6		Ø		2		Ø		3		Ø		2						Ø		16	
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		2	2	3	.67		0			2	3	5	.60		0				0				0			4	5	8	.62
i		variants		f		variants		f		variants		f														variants		f	
		s		1						č		1														č		2	
		č		1						dist		1														s		2	
š										s		1																	

Table 4 (cont'd)

	Grade																						Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0			4	6	12	.50	3	3	4	.75		0				0				0			4	5	8	.62
m					variants			f	variants			f													variants			f
					s			5	č			3													č			4
					č			1																	s			5
š																												
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0			1	1	1	1	2	3	3	1		0				0				0			3	4	4	1
f					variants			f	variants			f													variants			f
					∅			1	č			1													∅			1
									dist			1													č			1
									s			1													s			1
																									dist			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	13	.08		0			1	1	1	1		0			2	2	6	.33	2	3	11	.27	6	7	31	.23
i	variants		f						variants			f					variants		f		variants		f		variants			f
t	∅		1						∅			1					∅		2		∅		3		∅			7

Table 4 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	7	10	31	.32	2	2	11	.18	7	11	50	.22	5	17	81	.21	17	38	88	.43	9	17	59	.29	47	95	320	.30
m	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	Ø		10		Ø		2		Ø ?		8 3		Ø ?		12 5		Ø ?		34 4		Ø		17		Ø ?		83 12	
t	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	12	31	220	.14	21	94	330	.29	14	90	262	.34	6	52	139	.39	16	66	194	.34	15	54	119	.45	84	387	1264	.31
f	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	Ø ?		29 2		Ø ? d		69 23 2		? Ø k		47 42 1		Ø ?		38 14		Ø ?		52 14		Ø ?		41 13		Ø d k ?		271 2 1 113	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	5	9	14	.64	4	4	23	.17	4	6	9	.67	1	1	4	.25	2	2	2	1	1	1	1	1	17	23	53	.43
i	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	t d		8 1		t f		3 1		t f		4 2		f		1		t f		1 1		t		1		d f t		1 5 17	
θ																												

Table 4 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	6	9	14	.64	14	20	25	.80	14	23	25	.92	7	21	23	.91	4	6	6	1	5	5	6	.83	50	84	99	.85
m	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	Ø			4	Ø			12	Ø			15	Ø			20	Ø			6	Ø			3	Ø			60
	f			3	t			3	f			5	f			1					f			2	f			12
	p			1	s			2	p			2													p			4
	t			1	f			1	?			1													s			2
					p			1																	t			4
					?			1																	?			2
θ	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	15	37	57	.65	21	60	92	.65	19	49	62	.79	21	52	65	.80	16	31	34	.91	15	22	26	.85	107	251	336	.75
f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	f			13	t			29	t			23	t			43	t			17	t			16	Ø			28
	d			9	f			14	f			17	f			8	f			8	f			4	d			19
	t			8	Ø			9	Ø			7	Ø			1	Ø			4	Ø			1	f			64
	Ø			6	d			6	d			1					d			2	d			1	s			2
	?			1	z			1	s			1													t			136
					s			1																	z			1
																									?			1

Table 4 (cont'd)

Target	Grade 1				2				3				4				5				6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	22	222	306	.73	28	413	494	.84	28	479	521	.92	28	189	264	.72	25	143	242	.59	28	133	160	.83	159	1579	1987	.79
i	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	d		201		d		359		d		425		d		136		d		96		d		102		Ø		260	
	Ø		21		Ø		54		Ø		54		Ø		53		Ø		47		Ø		31		d		1319	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				4	11	28	.39	3	6	17	.35	2	4	18	.91	0				0				9	21	63	.33
m					variants		f		variants		f		variants		f										variants		f	
					d		11		v		4		d		3										d		16	
									d		2		v		1										v		5	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	3	3	8	.38	2	2	7	.29	2	2	7	.29	0				2	2	4	.50	2	3	5	.60	11	12	31	.39
m	variants		f		variants		f		variants		f						variants		f		variants		f		variants		f	
	b		3		Ø		2		f		1						Ø		2		Ø		3		Ø		8	
v									Ø		1														b		3	
																									f		1	

Table 4 (cont'd)

Target		Grade 1				2				3				4				5				6				Total Variants			
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		4	7	9	.78	11	17	62	.27	5	7	15	.47	3	3	6	.50	4	4	10	.4	2	2	5	.40	29	40	107	.37
v	f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
		Ø			7	Ø			17	Ø			7	Ø			3	Ø f			2 2	Ø f			1 1	Ø f			37 3
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0				0				3	3	34	.09	0				1	1	1	1	0				4	4	35	.11
w	i									variants			f					variants			f					variants			f
										Ø v			2 1					r			1					Ø r v			2 1 1
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0				1	1	1	1	0				0				0				0				1	1	1	1
z	i					variants			f																	variants			f
						s			1																	s			1

02

Table 4 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				1	2	3	.67	0				0				0				0				1	2	3	.67
m					variants			f																	variants			f
					Ø			1																	Ø			1
					w			1																	w			1
z																												
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	5	9	32	.28	10	16	165	.10	9	14	151	.09	2	3	38	.08	6	10	92	.11	2	2	17	.12	34	54	495	.11
f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	Ø			6	Ø			11	Ø			7	Ø			3	s			5	s			1	Ø			33
	s			3	s			3	s			5					Ø			5	Ø			1	d			2
					d			2	dist			2													s			17
																									dist			2
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1	0				0				0				0				0				1	1	1	1
b l l	variants			f																					variants			f
	Ø			1																					Ø			1

Table 4 (cont'd)

Target	Grade																								Target Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	3	4	11	.36	6	14	18	.78	1	2	2	1			0		2	2	6	.33	2	3	3	1	14	25	40	.62
br r	variants			f	variants			f	variants			f					variants			f	variants			f	variants			f
	Ø			4	Ø w			8 6	w			2					w			2	Ø			3	Ø w			15 10
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	3	3	1	3	3	6	.50	1	1	1	1			0				0				0		5	7	10	.70
d	variants			f	variants			f	variants			f													variants			f
	ǰ			3	ǰ			3	g			1													g j			1 6
dr	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				2	2	5	.40	0				0				0				0				2	2	5	.40
r					variants			f																	variants			f
					Ø			2																	Ø			2

Table 4 (cont'd)

Target	Grade 1				2				3				4				5				6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	2	2	2	1		0				0				0				0				0			2	2	2	1
fr r	variants			f																					variants			f
	w			2																					w			2
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1		0				0				0				0				0			1	1	1	1
gl l	variants			f																					variants			f
	Ø			1																					Ø			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1	1	6	6	1		0				0				0				0			2	7	7	1
gr r	variants			f	variants			f																	variants			f
	Ø			1	w			4																	Ø			2
					Ø			1																	w			4
					l			1																	l			1

Table 4 (cont'd)

Target	Grade																						Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1			0				0				0				0								1	1	1	1
k	variants			f																					variants			f
	g			1																					g			1
kl																												
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1			0				0				0				0								1	1	1	1
l	variants			f																					variants			f
	Ø			1																					Ø			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0				0				0				0			1	1	1	1		0			1	1	1	1
kr	r																variants			f					variants			f
																	w			1					w			1

Table 4 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0			2	2	6	.33		0			1	4	4	1		0				0			3	6	10	.60
pl l					variants			f					variants			f									variants			f
					w			1					w			4									Ø			1
					Ø			1																	w			5
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1		0				0				0				0				0			1	1	1	1
pr r	variants			f																					variants			f
	Ø			1																					Ø			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1	1	1	1	1		0				0				0				0			2	2	2	1
sk s	variants			f	variants			f																	variants			f
	Ø			1	Ø			1																	Ø			2

Table 4 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	2	2	2	1	1	1	1	1	3	3	3	1	1	1	1	1			0		1	1	1	1	8	8	8	1
w	variants			f	variants			f	variants			f	variants			f					variants			f	variants			f
skw	Ø			2	Ø			1	Ø			3	Ø			1					Ø			1	Ø			8
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				0				1	1	1	1	0				0				0				1	1	1	1
s									variants			f													variants			f
									Ø			1													Ø			1
sℓ	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				0				1	1	1	1	0				0				0				1	1	1	1
ℓ									variants			f													variants			f
									Ø			1													Ø			1

Table 4 (cont'd)

Target	Grade 1				2				3				4				5				6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0			1	1	1	1	1	1	1	1		0				0				0			2	2	2	1
tr r					variants			f	variants			f													variants			f
						w		1		Ø		1														Ø		1
																										w		1

Target	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	2	2	1		0				0				0				0				0			1	2	2	1
θ	variants			f																					variants			f
		t		2																						t		2
θr																												

Table 4 (cont'd)

Target	Grade																						Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	3	3	1	2	5	5	1			0				0				0				0		3	8	8	1
θr r	variants			f	variants			f																	variants			f
	Ø			3	w			4																	Ø			4
					Ø			1																	w			4

Total Variants	610	1212	1069	677	676	519	= 4763
Omissions	305	639	434	397	472	338	= 2585
Substitutions	303	573	628	280	204	181	= 2169
Distortions	2	0	7	0	0	0	= 9

*For each cell n is the number of children in the column grade who produced a variant of the row target phoneme. The number of occurrences of the target phoneme in the speech samples from that grade is indicated by the o value, and the number of variations produced is indicated by the f value. Relative frequency (rf) is obtained by dividing f by o. In the lower part of each cell, the type of variant and the number of occurrences of each is noted.

4.1.2. Summary of most stable variants. Table 5 is a summary, derived from Table 3, of all the variations which occurred five times or more on the Goldman-Fristoe test, summed across grades. Target phonemes are rank ordered from the one (/θ/) which had the most variants associated with it down to the target with the fewest variants.[2] For each target phoneme, the adjusted frequency of total variants is given in the first frequency column. Then, the adjusted frequency is noted for each variant which had an adjusted frequency of more than five. It will frequently be the case, then, that the sum of the frequencies of the variants of a particular target will be smaller than the total frequency for that target. This is because other variants occurred with a frequency less than five and were not reported on the summary table.

Table 5 also includes the features changed in the case of substitutions. Feature changes are noted by change in +/- feature value and also by change in the marking value of each feature. (Recall that Appendix A presents the linguistic background for the analysis of substitution errors in terms of phonetic features.) The feature data of Table 5 will be referred to in the following chapter where a linguistic analyses of the substitutions will be presented.

4.1.3. Goldman-Fristoe variants compared with those of Free Speech samples. When an articulation test, such as the Goldman-Fristoe, is administered to an individual there is the tacit assumption on the part of

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[2]The frequencies reported on Table 5 and elsewhere in this section are adjusted frequencies. This means that if the target phoneme occurred more than once in the Goldman-Fristoe test, the raw frequency of variation was divided by the number of occurrences on the Goldman-Fristoe. This was done so that all frequencies would be comparable to each other, as though each target appeared only once on the test. For example, initial /z/ appears once on the Goldman-Fristoe test, but final /z/ appears four times. Thus, row 13 of Table 5 reports the raw frequency of variation for initial /z/, but for final /z/ reports the raw frequency (39 -- see Table 3) divided by four. Thus, row 18 of Table 5 reports the raw frequency of the most stable variant of initial /z/, 15 substitutions of /s/. For final /z/ the frequencies of the most stable variants (/s/ substitution and omission, with raw frequencies of 15 and 23, respectively) are divided by four to produce the reported adjusted frequencies of 3.75 and 5.75. Thus, the reader can examine row 13 of Table 5 and compare, for example, /s/ for /z/ substitutions in initial and final positions, with no confounding due to frequency of occurrence.

Table 5

Summary of Frequencies and Feature Changes for Those Variants Produced by Speakers of BE on the Goldman-Fristoe Test with a Frequency Greater than Five

Target*	Position	Over-all Frequency of Variation of Target	Individual Variants	Frequency of Individual Variants	Change in +/- Features	Change in M/U Features
	i	37	f	18	-cor +str	U cor
			t	14	-cnt	U cor U cnt
			d	5	-cnt + voi	U cor U cnt M voi
θ (273)	m	126	f	98	-cor +str	U cor
			omit	21		
	f	110	f	96	-cor +str	U cor
			omit	11		

Table 5 (cont'd)

Target	Position	Over-all Frequency of Variation of Target	Individual Variants	Frequency of Individual Variants	Change in +/- Features	Change in M/U Features
ð (114)	i	107	d	106	-cnt	U cor U cnt U str
	m	7	d	5	-cnt	U cor U cnt U str
v (106)	i	63	b	58	-cnt -str	M cor U cnt U str
	m	15	b	13	-cnt -str	M cor U cnt U str
	f	28	omit	17		
			f	7	-voi	U voi
d (95)	f	95	t	75	-voi	U voi
			omit	15		

Table 5 (cont'd)

Target	Position	Over-all Frequency of Variation of Target	Individual Variants	Frequency of Individual Variants	Change in +/- Features	Change in M/U Features
b (78)	f	78	p	51	-voi	U voi
			omit	26		
p (55.5)	i	41	b	40	+voi	M voi
	f	14.5	omit	12.5		
	m	10.5	omit	10.5		
ð (52.3)	f	41.8	omit	41.8		
g (52)	f	52	k	35	-voi	U voi
			omit	15		
ɬ (47.33)	f	47.33	omit	46.67		
ǰ (44)	f	44	č	36	-voi	U voi
			omit	6		

Table 5 (cont'd)

Target	Position	Over-all Frequency of Variation of Target	Individual Variants	Frequency of Individual Variants	Change in +/- Features	Change in M/U Features
z (38.75)	i	19	s	15	-voi	U voi
	f	9.75	omit	5.75		
			s	3.75	-voi	U voi
r (34)	i	14.5	w	14	-cns -voc -ant -cor -lat	-cns
	m	19.5	w	15.5	-cns -voc -ant -cor -lat	-cns
n (30.4)	m	6.4	omit	5.4		
	f	24	omit	21		

Table 5 (cont'd)

Target	Position	Over-all Frequency of Variation of Target	Individual Variants	Frequency of Individual Variants	Change in +/- Features	Change in M/U Features
š (27)	i	11	č	5	-cnt	U cnt
	m	8	č	3	-cnt	U cnt
	f	8	č	3	-cnt	U cnt
s (13)	f	13	omit	12.5		
č (12)	f	12	t	5	+ant -str	U ant U cor U str
t (11.5)	f	11.5	omit	8		
f (9)	f	9	omit	6		
m (6.33)	f	6.33	omit	5.33		

*Target phonemes are rank ordered according to frequency of variants associated with each. The total frequency associated with each target appears in parentheses below the target symbol; however, only those variants are reported which had a frequency of greater than five. All frequencies are adjusted frequencies if the target appeared more than once in the Goldman-Fristoe test (see Footnote 2, this section, for a detailed discussion of the adjusted frequency figure).

the administrator that the phonetic performance of the individual on the test will be essentially similar to that of his everyday speech behavior. Table 6 presents information which can be used to evaluate the validity of that assumption. On that table the rows are either particular target phonemes or individual variants of a target. (Thus, row 15 deals with all variants associated with the target phoneme /θ/ in initial position, while row 18 is concerned only with /f/ for /θ/ substitutions in all positions.) For each target (or variant) defined on a row, the total number of children producing that variant (in either Goldman-Fristoe or Free Speech) is noted in the first column. Other columns present the proportion of the total number of children producing that variant in (1) Both speech modalities; (2) Free Speech only; (3) Goldman-Fristoe only. The third category is further divided among those who failed to produce the variant in Free Speech because the target never occurred in their speech sample -- the N/O (no opportunity) column -- and those who produced the target with no variation in the Free Speech -- the N/V (no variant) column.

The ideal situation (from the point of view of test accuracy) would be for 100% of the subjects to fall in the "Variant in both GF and FS" and the "No opportunity for variation" categories. Both the other columns represent test inaccuracies: Entries in the "No variation" column represent instances of misprediction, where a child was expected (on the basis of the Goldman-Fristoe test) to produce a variant in Free Speech which he in fact did not produce. Entries in the "Free Speech only" column represent instances of the failure of the articulation test to predict Free Speech errors. For the following three variants, more than half the total subjects producing that variant did so on the Goldman-Fristoe test and failed to produce the same variant in Free Speech: /b/ substitution for /p/ in initial position; /f/ substitution for /v/ in final position; and omission of final /s/. For four variants, more than half the total children who produced that variant did so only in Free Speech. These are omission of final /d/; /d/ substituting for /ð/ in medial position; /t/ substituting for /θ/ in all positions, and omission of /θ/ in all positions.

These data seem to indicate that the Goldman-Fristoe test of articulation alone probably does not present an accurate phonetic profile of individual subjects for all phonemes. However, many of the variants tabulated on Table 6 show a high degree of stability across speech modalities.

4.1.4. Variants attributable to dialect as against variants attributable to developmental factors. One of the major goals was to determine which phonetic variations seem to be associated with Black dialect and which seem to be articulatory variations attributable to developmental factors. Variants which do not decrease in frequency across the six grades investigated can be assumed to persevere in the adult community and can be assumed to be variants attributable to dialect. On the other hand, variants

Table 6

Relationships Among Goldman-Fristoe (G-F) and Free Speech (F-S)

Variants in BE Group

Variant*	n**	Produced Variant on G-F, but not on F-S		Produced Variant on both G-F and F-S	Produced Variant on F-S, but not on G-F
		N/V***	N/O****		
/p/ for /b/	53	4	45	2	2
(f)		.07	.85	.04	.04
Omit /b/	27	2	19	5	1
(f)		.07	.70	.19	.04
/t/ for /d/	97	27	6	42	22
(f)		.28	.06	.43	.23
Omit /d/	85	2	2	10	71
(f)		.02	.02	.12	.84
/k/ for /g/	42	6	19	10	7
(f)		.14	.45	.24	.17
Omit /g/	14	2	8	4	0
(f)		.14	.57	.29	.00
/č/ for /ǰ/	36	6	28	1	1
(f)		.17	.78	.03	.03
Omit /ǰ/	9	0	4	2	3
(f)		.00	.44	.22	.33
/f/ for /v/	9	5	1	1	2
(f)		.56	.11	.11	.22

Table 6 (cont'd)

Variant	n	Produced Variant on G-F, but not on F-S: N/V	Produced Variant on G-F, but not on F-S: N/O	Produced Variant on both G-F and F-S	Produced Variant on F-S, but not on G-F
/b/ for /v/	59	9	50	0	0
(i)		.15	.85	.00	.00
Omit /v/	39	8	4	3	24
(f)		.21	.10	.08	.62
/s/ for /z/	21	8	0	3	10
(f)		.38	.00	.14	.48
Omit /z/	35	13	3	3	16
(f)		.37	.09	.09	.46
Omit /s/	30	16	4	3	7
(f)		.53	.13	.10	.23
All /θ/ Variants	48	11	20	6	11
(i)		.23	.42	.13	.23
All /θ/ Variants	134	17	67	41	9
(m)		.13	.50	.31	.07
All /θ/ Variants	148	12	28	70	38
(f)		.08	.19	.47	.26
/f/ for /θ/	136	55	32	38	11
all positions		.40	.24	.28	.08
/t/ for /θ/	91	6	3	8	74
all positions		.07	.03	.09	.81

Table 6 (cont'd)

Variant	n	Produced Variant on G-F, but not on F-S		Produced Variant on both G-F and F-S	Produced Variant on F-S, but not on G-F
		N/V	N/O		
Omit /θ/ all positions	61	11 .18	6 .09	8 .13	36 .59
/d/ for /ð/ (i)	165	5 .03	2 .01	100 .61	59 .36
/d/ for /ʒ/ (m)	13	5 .38	0 .00	0 .00	8 .62
Omit /l/ (m)	38	6 .16	4 .11	27 .71	1 .03
Omit /l/ (f)	89	8 .09	3 .03	59 .66	19 .21
Omit /ð/ (m)	57	5 .09	1 .02	25 .44	26 .46
Omit /ð/ (f)	141	13 .09	0 .00	88 .62	40 .28
/b/ for /p/ (i)	45	24 .53	10 .22	6 .13	5 .11

*Substitution variants are indicated by noting that one phoneme was produced 'for' another. Position of the variant is indicated in parentheses below the specification of the variant. Thus, the first row indicates the substitution pf /p/ for /b/ in final position.

**n indicates the number of subjects who produced the indicated variant on either Goldman-Fristoe or in Free Speech.

Table 6 (cont'd)

***N/V indicate the number (and proportion) of subjects who produced the target phoneme in Free Speech, but did not produce the indicated variant.

****N/O indicates the number and proportion of subjects whose Free Speech sample did not include the target phoneme (thus, there was, for these subjects, no opportunity to produce the variant).

which decrease over time probably do not exist in any significant degree in the adult speech community and can be assumed to have a developmental origin. Henceforth, a general lack of decrease or a general increase of variants over grades will be referred to as a "dialect pattern" and a general decrease will be referred to as a "developmental pattern."

4.1.4.1. Word-final obstruents. The initial data analysis (as presented in Tables 3 and 4) involved the computation of the frequency of individual variants for each grade level. Initial computations revealed that the two patterns mentioned above could be discerned in the frequency by grade relationships of the most vulnerable target phonemes. In particular, for all the voiced final obstruents (/v/, /z/, /b/, /d/, /g/, and /ǰ/) one type of variation (omission) followed the developmental pattern, while the other common type of variation (devoicing) followed a dialect pattern. Figure 1[3] graphically depicts these relationships. The frequency of omissions of final voiced obstruents decreased across grade levels. The substitution of the voiceless final obstruent (/f/, /s/, /p/, /t/, /k/, and /č/, respectively) dipped slightly in the middle grades, then increased in the fifth and sixth grades. While Figure 1 depicts the patterns associated with all the word-final obstruents, Table 3 shows that these patterns were valid for each of the word-final obstruents individually.

To ascertain whether the frequencies revealed in Figure 1 do in fact differ from chance, an analysis of variance was performed on the data. For each subject a "developmental" score was derived by computing the average number of obstruent-final omissions in the Goldman-Fristoe data of that subject. A "dialect" score was also derived by computing the average number of obstruent-final devoicings in the Goldman-Fristoe data of that subject. These scores were then subjected to a six (grades) by two (omissions vs. devoicings) analysis of variance. The analysis revealed that the combined frequency of both types of variants differed across grades, $F(5, 188) = 2.773$, $p < .05$. There were, overall, significantly more devoicings (dialect variants) than omissions (developmental variants) $F(1, 188) = 49.758$, $p < .01$. The mean dialect score per subject was .19, while the mean developmental score was .07. The most interesting aspect of the analysis, however, is the interaction of grade by type of variant. This interaction is also highly significant, $F(5, 188) = 5.165$, $p < .01$.

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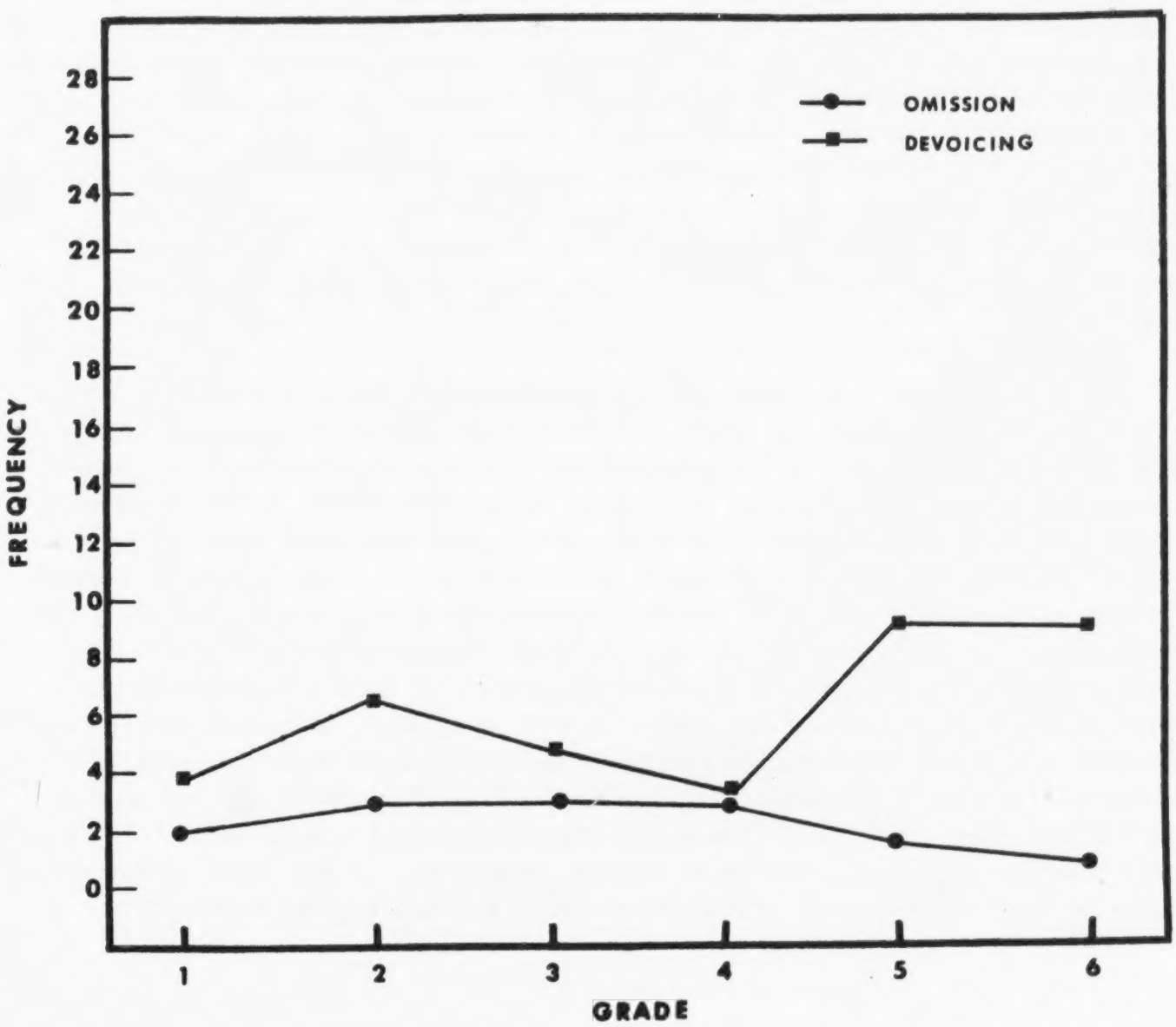
[3] On this and all Figures depicting target phonemes which occurred more than once in the Goldman-Fristoe test, the frequency measure of the ordinate is an adjusted frequency (see footnote #2, this section).

Figure 1

Omissions (Developmental Variants) and Devoicing Substitutions (Dialect Variants) by Grade for BE Group



Duncan Multiple Range post-tests were carried out to ascertain exactly which grade differences were responsible for the significant results of the analysis of variance. None of the means of omissions differ significantly from each other. That is, the bottom line of Figure 1, while it reveals a general decrease in incidence of omission of final voiced obstruent across grades, the grade differences are not significant. Examination of the substitution of the voiceless counterpart of the final voiced obstruent (the upper line of Figure 1) reveals the significant aspects of the analysis. The incidence of devoicings in the fifth and sixth grades is greater than in the first, third and fourth grades. Thus, the differential incidence of devoiced variants across grades is responsible for the significance of the 'grade' main effect. Furthermore, the significance of that variable is attributable to a real increase in frequency in the later grades, rather than to the inexplicable drop in devoicings in the third and fourth grades. The post-test demonstrates also that the major component of the significant interaction between type of error and grade is attributable to the divergence of frequency scores in the fifth and sixth grades.

Thus, the anticipation that the two different types of variations associated with voiced obstruents in word-final position pattern differently is tentatively confirmed. The importance of this finding will be developed in more detail in the following section.

Variants of other target phonemes were found to pattern differentially such that in each both a developmental and a dialect pattern could be discerned. Each of these four phonemes, /θ/, /d/, /ð/, and /ɫ/, will be considered separately. Again, a discussion of the linguistic significance of these results will be postponed until the following section.

4.1.4.2. Omission of /ð/. Figure 2 displays the differential distribution of /ð/ omissions, dependent upon position of the target phoneme. (By "omission of /ð/" we mean, of course, omission of the consonantal aspect of that phoneme, leaving only a schwa-quality vowel.) Omissions of /ð/ in final position increase over grades and clearly show what is identified as a dialect pattern. Omission of /ð/ in medial position, on the other hand, shows a general decrease in frequency over grades in accordance with a developmental pattern. Chi square tests[4] were carried out on omissions in each position to ascertain

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[4]Differential frequencies across grades for /ð/, /θ/, /d/, and /ɫ/ were analyzed by the Chi Square statistic. The reason for this is that for each phoneme, a subject's developmental and dialect scores were either "0" or "1", since only one instance of each type of variant was possible for each phoneme.

Figure 2

Incidence of Omission of /ð/ in Medial and Final Position by Grade for BE Group

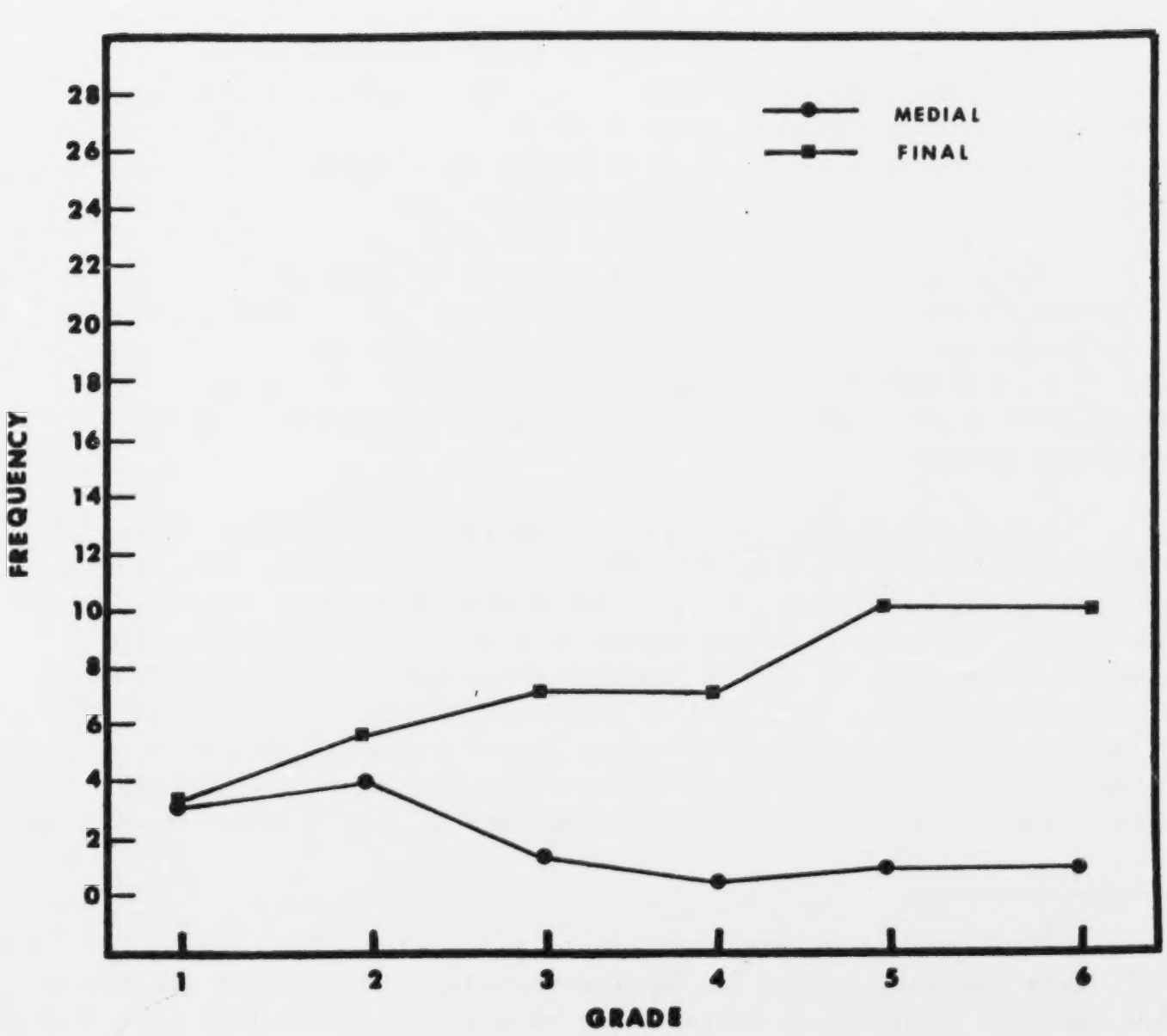
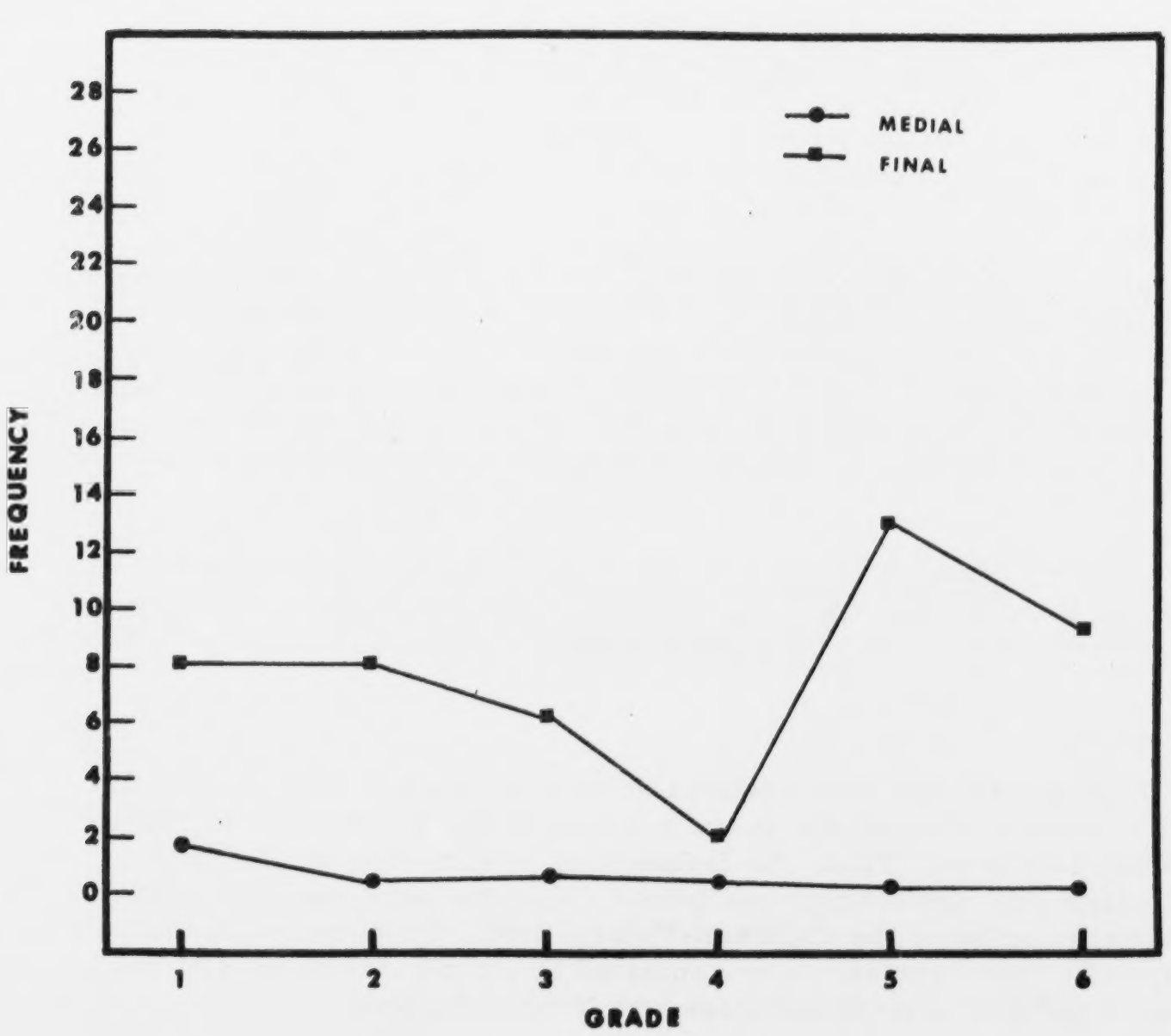


Figure 3

Incidence of Omission of /ℓ/ in Medial and Final Position by Grade for BE Group



if the frequency distributions across grades differed from chance. For final omissions of /ð/, χ^2 = 24.7 (df = 5), p = .004 and for medial omissions, χ^2 = 20.6 (df = 5), p = .001. The more interesting statistic is the two-way chi square, which demonstrates the significant divergence of the two frequency distributions. χ^2 for the two-way test = 37.1 (df = 5), p = .0001. The significance of the two-way Chi Square indicates an interaction of omissions in the two positions with the grade variable. The greater than chance divergence of the two frequency distributions demonstrates that two separate patterns, corresponding to the position of the target phoneme, have been isolated.

4.1.4.3. Omission of /l/. Like /ð/, omissions of final /l/ follow the dialect pattern, as shown in Figure 3, while omissions of initial and medial /l/ follow the developmental pattern (note that /ð/ does not appear in initial position, so only medial /ð/ was considered). χ^2 for final omissions = 25.9 (df = 5), p = .0002 and χ^2 for initial and medial omissions = 11.7 (df = f), p = .04. The two-way chi square reveals χ^2 = 5.7 (df = 1) p = .02, indicating a greater than chance divergence. Thus, omission of medial /l/ decreases across grades and omission of final /l/ increases across grades. The interaction of the position variable with the grade variable (revealed by the significant two-way Chi Square) demonstrates that two distinct patterns, corresponding to the position of the target phoneme, have been isolated.

4.1.4.4. All types of variants of /θ/. Figure 4 shows the developmental pattern of variants associated with /θ/ in initial position (χ^2 = 12.8 (df = 5), p = .02) and the dialect pattern of /θ/ variants occurring in medial and final positions[5] (χ^2 = 9.5, df = 5, p = .08). The two-way chi square produces χ^2 = 9.4 (df = 5), p = .09, indicating that the divergence of the two distributions is not greater than might have been expected by chance.

4.1.4.5. Substitution of /d/ for /ð/. Figure 5 presents the frequency of the /d/ for /ð/ substitution in two positions -- initial and medial. Substitutions in initial position appear to follow a dialect pattern

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[5]Frequencies are also adjusted on graphs (such as Figure 4) which compare incidence of variation in one position to the incidence of variation in two other positions. Thus, the frequencies of variation of /θ/ in initial position are raw frequencies (since there was only one /θ/ occurring in initial position on the Goldman-Fristoe test. Frequencies associated with the medial final variations are adjusted by simply adding medial raw frequencies and final raw frequencies and dividing by two.

Figure 4

Incidence of Variants (of all types) Associated with /θ/ in Initial and Medial + Final Positions by Grade for BE Group

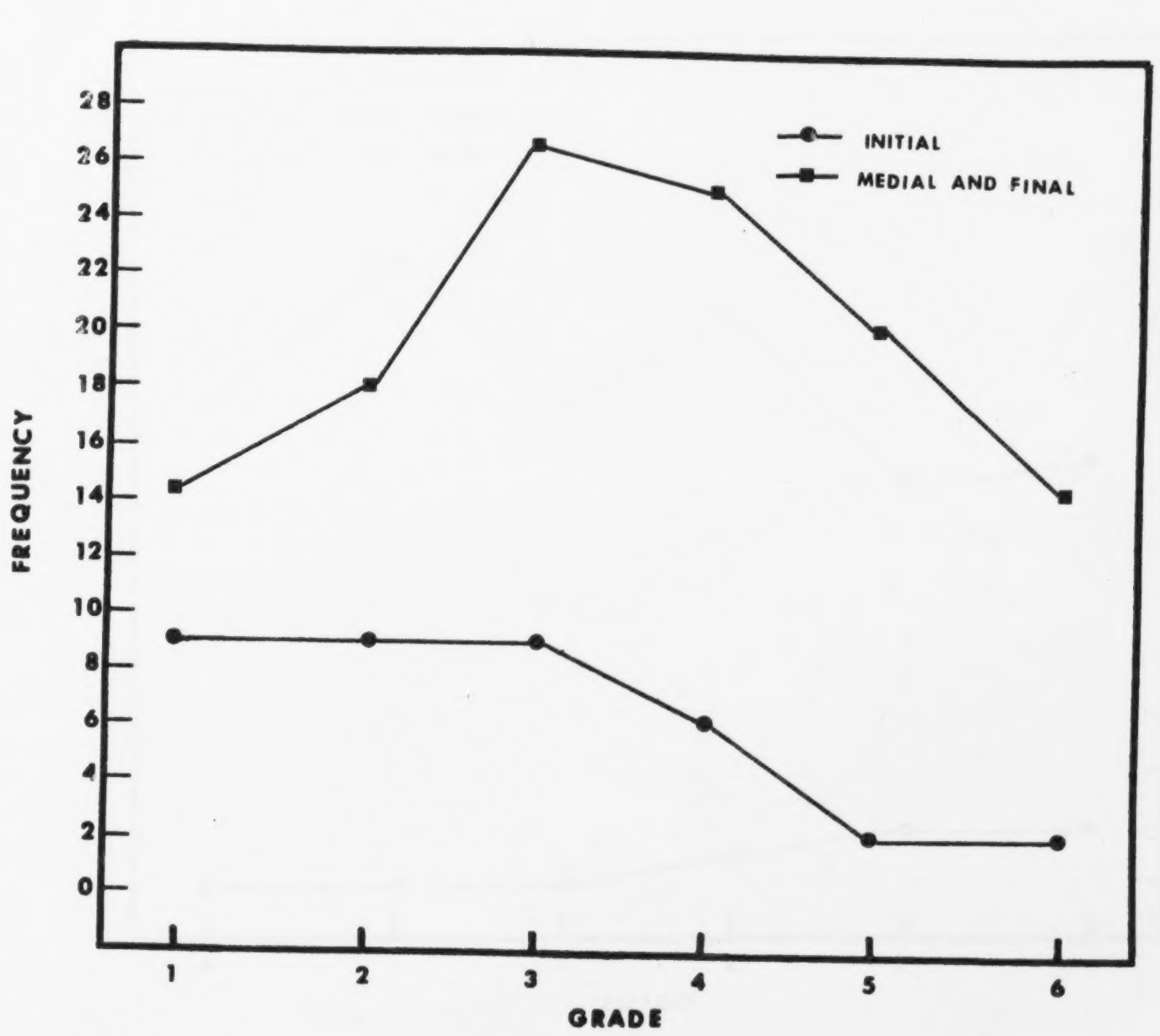
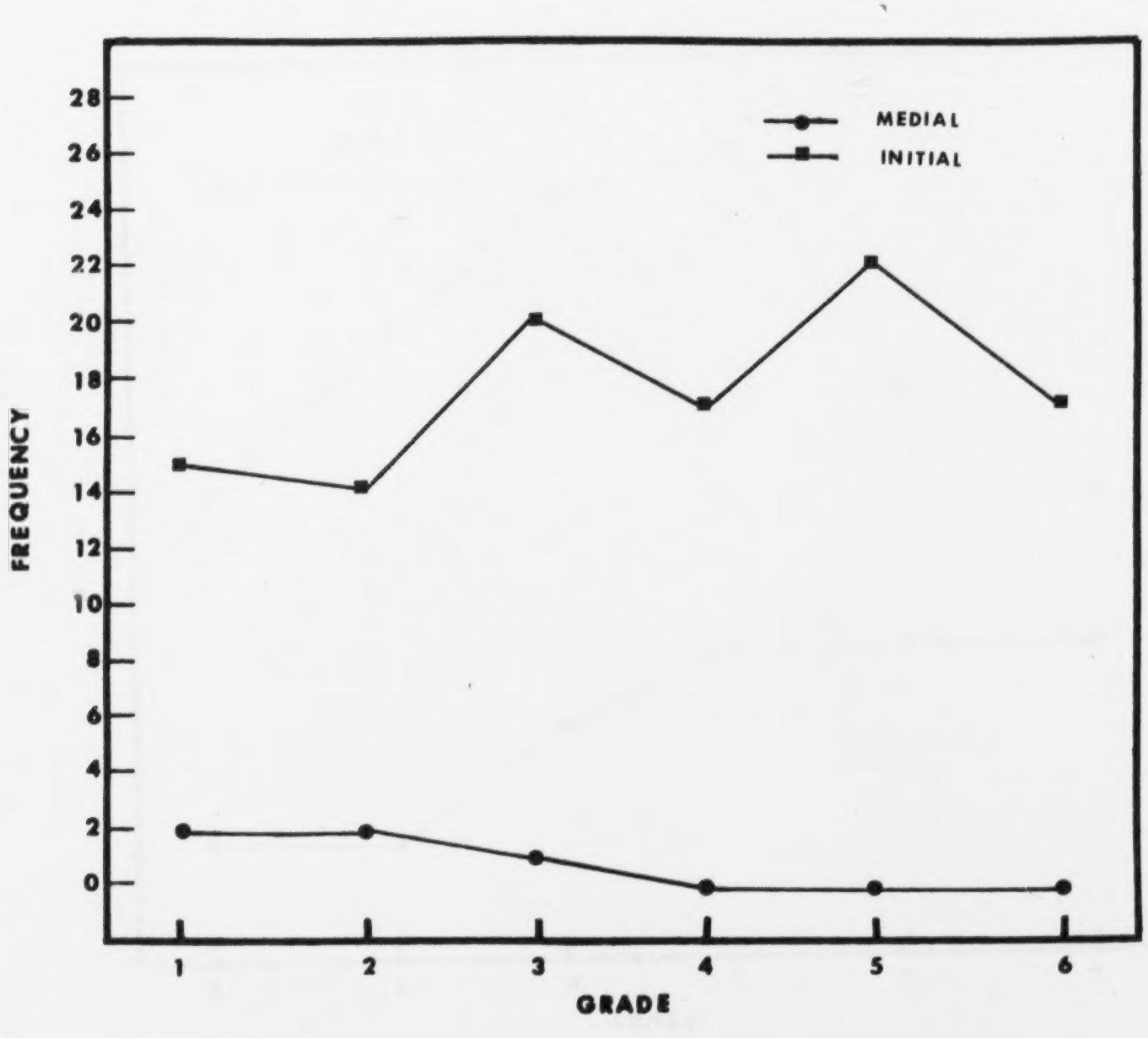


Figure 5

The Substitution of /d/ for /ð/ in Initial and Medial Position by Grade for BE Group



with an overall increase across grades. However, a Chi Square test on this distribution indicates only chance distribution across grades substitution of /d/ for medial /ð/ is a very low frequency event, but the few instances of that variation do occur in the early grades, indicating a slight developmental pattern, but not beyond a chance variation.

Thus, differential dialect as against developmental patterns are discernable in ten of the target phonemes for the Niagara Falls speakers of Black English. The validity of these patterns, as well as their theoretical significance will be discussed in Section 5.

4.2. San Antonio: The Mexican-American Sample

4.2.1. Raw data presentation. Tables 7 and 8 report the data from the San Antonio sample. The former table is for Goldman-Fristoe data, the latter for Free Speech. The rows, columns, and cell entries are exactly the same as tables 3 and 4 for Niagara Falls sample. (See page 20 for a detailed description of cell entries.)

4.2.2. Summary of most stable variants. Table 9, which reports variations which occurred in the San Antonio Goldman-Fristoe data with a frequency greater than five is analagous to Niagara Fall's Table 5. Target phonemes are rank ordered from the one (/z/) which produced the most variants associated with it, down to the target with the fewest variants. Table 9 (like Table 5) also includes the features changed in the case of substitutions. Feature changes are noted by a change in +/- feature value and also by change in the marking value of each feature. Data reported on Table 9 are adjusted frequencies where relevant (see footnote 2, this section, for a definition of adjusted frequency). The linguistic significance of these variants will be discussed fully in the following chapter.

4.2.3. Goldman-Fristoe variants compared with those of Free Speech samples. Table 10 presents, for the San Antonio sample, the same information that Table 6 reports for the Niagara Falls sample. This table provides a basis for evaluating the stability of phonetic performance across speech modalities.

In general, it appears that the Goldman-Fristoe better predicts phonetic performance in the free speech of the Mexican-American child than it does for the Black child. Only two variants, /f/ substituting for /θ/ in final position and /b/ substituting for /v/ in final position, show more than half the subjects failing to produce in Free Speech the variant they produced on the Goldman-Fristoe test. The Goldman-Fristoe test failed to predict Free Speech variations for more than half

(text continued on page 162)

Table 7

Variants Produced by Speakers of MAE on the Goldman-Fristoe Test of Articulation*

	Grade 1			Grade 2			Grade 3			Grade 4			Grade 5			Grade 6			Total Variants		
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	5	10	.50	1	1	.25	2	4	.50		0		4	5	.31	1	1	.25	13	21	.40
(4)m	variants	f		variants	f		variants	f					variants	f		variants	f		variants	f	
	Ø	10		Ø	1		Ø	4					Ø	5		Ø	1		Ø	21	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	12	25	.42	11	12	.22	4	7	.35	1	4	.80	10	19	.38	4	7	.35	42	74	.35
(5)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	Ø	25		Ø	12		Ø	7		Ø	4		Ø	18		Ø	7		Ø	73	
													ℓ	1					ℓ	1	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	1		0			0			0			0		1	1	1	2	2	1
(1)m																variants	f		variants	f	
																v	1		p	1	
																			v	1	

Table 7 (cont'd)

Target		Grade 1			Grade 2			Grade 3			Grade 4			Grade 5			Grade 6			Total Variants		
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		16	16	1	14	14	1	12	12	1	5	5	1	11	11	1	4	4	1	62	62	1
b (1)f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
		p	14		p	13		p	11		p	5		p	11		p	4		f	3	
		f	1		f	1		f	1											Ø	1	
		Ø	1																	p	58	
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		16	23	.72	20	29	.72	16	25	.78	15	20	.67	11	11	.50	10	14	.70	88	122	.69
(2)i		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
		š	19		š	26		š	22		š	18		š	11		š	13		s	5	
		s	2		s	2		dist	2		dist	1					t	1		š	109	
		ts	1		t	1		t	1		s	1								t	4	
č		t	1																	ts	1	
																				dist	3	

Table 7 (cont'd)

Target		Grade 1			2			3			4			5			6			Total Variants		
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		10	10	1	14	14	1	12	12	1	11	11	1.0	11	11	1.0	8	8	1.0	66	66	1
	(1)m	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
		š	7		š	12		š	11		š	10		š	11		š	8		s		1
		ts	1		t	2		t	1		dist	1								š		59
		t	1																	t		4
		s	1																	ts		1
																				dist		1
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		20	20	1	15	15	1.0	20	20	1.0	8	8	1.0	13	13	1.0	6	6	1.0	82	82	1
	(1)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
		š	19		š	15		š	19		š	7		š	13		š	6		š		79
		t	1					dist	1		dist	1								t		1
																				dist		2
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
			0			0		2	2	1		0			0			0		2	2	1
d	(1)i							variants		f										variants		f
								t		2										t		2

Table 7 (cont'd)

Target	Grade 1			2			3			4			5			6			Total Variants		
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		0			0			0			0			0		1	1	1	1	1	1
(1)m																variants		f	variants		f
																	Ø	1		Ø	1
d	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	22	22	1	12	12	1	16	16	1	8	8	1	12	12	1	19	19	1	89	89	1
(1)f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
	t		20	t		11	t		15	t		7	t		10	t		19	Ø		7
	Ø		2	Ø		1	Ø		1	Ø		1	Ø		2				t		82
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	3	3	.33	1	1	.33	1	2	.67		0		1	1	.33		0		6	7	.39
(3)i	variants		f	variants		f	variants		f				variants		f				variants		f
f	p		3	p		1	p		2				p		1				p		7

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	3	3	1	1	1	1	1	1	1		0			0		1	1	1	6	6	1
f (1)f	variants		f	variants		f	variants		f							variants		f	variants		f
		s	3		Ø	1		Ø	1								s	1		Ø	2
																				s	4
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	1	1	1	1		0			0			0			0		2	2	1
(1)i	variants		f	variants		f													variants		f
		d	1		d	1														d	2
g																					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	2	2	1	1	1	1		0			0			0			0		3	3	1
(1)m	variants		f	variants		f													variants		f
		d	1		k	1														d	1
		k	1																	k	2

Table 7 (cont'd)

Target	Grade 1			2			3			4			5			6			Total Variants		
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	19	19	1	13	13	1	12	12	1	7	7	1	10	10	1	3	3	1	64	64	1
g (1)f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
	k	16		k	12		k	11		k	7		k	9		k	3		Ø		2
	?	1		Ø	1		Ø	1					?	1					k		58
	t	1																	?		2
	dist	1																	t		1
																			dist		1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		0		2	2	1	2	2	1		0		1	1	1		0		5	5	1
(1)i				variants		f	variants		f				variants		f				variants		f
					d	1		d	1					d	1					d		3
j					č	1		ž	1											č		1
																				ž		1

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	3	3	1	6	6	1	2	2	1	1	1	1	2	2	1		0		14	14	1
(1)m	variants		f	variants		f	variants		f	variants		f	variants		f				variants		f
		d	2		d	2		d	1		y	1		d	2					č	2
		č	1		y	2		y	1											d	7
					č	1														y	4
					Ø	1														Ø	1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	11	11	1	17	17	1	11	11	1	9	9	1	11	11	1	4	4		63	63	1
(1)f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
		č	7		č	16		č	9		č	9		č	9		č	4		č	54
		š	3		ž	1		š	2					z	1					s	1
		s	1											Ø	1					š	5
																				ž	1
																				z	1
																				Ø	1

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	4	4	.33	1	1	.33		0			0		2	2	.33		0		7	7	.33
(3)i	variants	f		variants	f								variants	f					variants	f	
	t	4		t	1								t	2					t	7	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	2	2	.50	1	1	.50	1	1	.50	1	1	.50		0			0		5	5	.50
(2)m	variants	f		variants	f		variants	f		variants	f								variants	f	
	t	1		Ø	1		f	1		Ø	1								Ø	2	
k	?	1																	f	1	
																			t	1	
																			?	1	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	3	3	1		0		1	1	1	1	1	1		0			0		5	5	1
(1)f	variants	f					variants	f		variants	f								variants	f	
	?	1					Ø	1		Ø	1								Ø	3	
	g	1																	g	1	
	Ø	1																	?	1	

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		0		2	2	.50	1	1	.50		0			0			0		3	3	.50
(2)m				variants		f	variants		f										variants		f
					Ø	2		Ø	1											Ø	3
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	18	41	.76	20	34	.57	11	20	.61	8	13	.54	17	31	.61	12	18	.50	86	157	.61
(3)f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
		Ø	33		Ø	34		Ø	20		Ø	13		Ø	31		Ø	16		Ø	147
		w	8														w	2		w	10
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	2	2	.50		0		1	1	.50		0			0			0		3	3	.50
(2)m	variants		f				variants		f										variants		f
		n	1					y	1											Ø	1
m		Ø	1																	n	1
																				y	1

Table 7 (cont'd)

Target	Grade 1			2			3			4			5			6			Total Variants		
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	3	3	.33	1	1	.33		0		1	1	.33		0			0		5	5	.33
m (3)f	variants	f		variants	f					variants	f								variants		f
	Ø	2		Ø	1					Ø	1								Ø		4
	n	1																	n		1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		0			0		1	1	1		0			0			0		1	1	1
(1)i							variants	f											variants		f
							d	1											d		1
n	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	.20		0		1	1	.20		0		1	1	.20		0		3	3	.20
(5)m	variants	f					variants	f					variants	f					variants		f
	Ø	1					Ø	1					Ø	1					Ø		3

Table 7 (cont'd)

Target		Grade 1			2			3			4			5			6			Total Variants		
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		10	11	.22	9	14	.31	6	7	.23	3	3	.20	1	1	.20	4	4	.20	33	40	.24
n	(5)f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
			Ø	9		Ø	13		Ø	7		Ø	3		Ø	1		Ø	4		Ø	37
			?	2		?	1														?	3
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		6	6	1	4	4	1	6	6	1	6	6	1		0			0		22	22	1
	(1)i	variants		f	variants		f	variants		f	variants		f							variants		f
			b	5		b	4		b	6		b	6								b	21
			w	1																	w	1
p		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		1	1	.33	2	2	.33	2	2	.33	1	1	.33		0			0		6	6	.33
	(3)m	variants		f	variants		f	variants		f	variants		f							variants		f
			b	1		b	2		b	2		b	1								b	6

Table 7 (cont'd)

Target	Grade 1			2			3			4			5			6			Total Variants		
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	6	6	.50	6	6	.50	1	1	.50	1	1	.50		0		3	3	.50	17	17	.50
p (2)f	variants	f		variants	f		variants	f		variants	f					variants	f		variants	f	
	Ø	6		Ø	6		Ø	1		Ø	1					Ø	3		Ø	17	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	6	8	.67	4	4	.50	5	5	.50	2	2	.50	10	11	.55		0		27	30	.56
(2)i	variants	f		variants	f		variants	f		variants	f		variants	f					variants	f	
	w	8		b	4		w	5		ℓ	1		w	11					b	4	
										w	1								ℓ	1	
																			w	25	
r	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	4	6	.75	3	3	.50	2	2	.50	1	1	.50	1	1	.50		0		11	13	.59
(2)m	variants	f		variants	f		variants	f		variants	f		variants	f					variants	f	
	w	5		w	2		w	2		w	1		w	1					Ø	2	
	Ø	1		Ø	1														w	11	

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	3	3	.50	4	5	.62	2	2	.50		0		2	3	.75	3	3	.50	14	16	.57
(2)i	variants	f		variants	f		variants	f					variants	f		variants	f		variants	f	
	θ	1		z	4		z	2					dist	2		č	1		θ	2	
	d	1		θ	1								z	1		z	1		č	1	
	dist	1														dist	1		d	1	
																			z	8	
																			dist	4	
s	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	6	6	.50	3	4	.67		0			0		2	2	.50	2	2	.50	13	14	.54
(2)m	variants	f		variants	f								variants	f		variants	f		variants	f	
	Ø	3		θ	2								Ø	1		Ø	2		Ø	6	
	θ	1		t	1								č	1					č	1	
	dist	1		ʧ	1														t	1	
	?	1																	θ	3	
																			ʧ	1	
																			?	1	
																			dist	1	

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	5	5	.50	1	2	1.0	1	1	.50	1	1	.50	1	1	.50		0		9	10	.56
s (2)f	variants	f		variants	f		variants	f		variants	f		variants	f					variants	f	
	Ø	3		θ	2		Ø	1		Ø	1		č	1					Ø	5	
	dist	1																	č	1	
	š	1																	š	1	
																			θ	2	
																			dist	1	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	16	16	1	12	12	1	9	9	1	16	16	1	12	12	1	14	14	1	79	79	1
(1)i	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	č	14		č	11		č	8		č	16		č	12		č	14		č	75	
	t	1		s	1		j	1											j	1	
š	s	1																	s	2	
																			t	1	

Table 7 (cont'd)

Target		Grade 1			2			3			4			5			6			Total Variants		
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		10	10	1	4	4	1	9	9	1	10	10	1	4	4	1	6	6	1	43	43	1
	(1)m	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
		č	9		č	4		č	9		č	10		č	4		č	6		č		42
		Ø	1																	Ø		1
s		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		11	11	1	9	9	1	9	9	1	15	15	1	9	9	1	9	9	1	62	62	1
	(1)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
		č	10		č	8		č	8		č	15		č	8		č	8		č		57
		s	1		dist	1		t	1					s	1		dist	1		s		2
																				t		1
																				dist		2
		n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
		1	1	.50		0		1	1	.50	1	1	.50		0		1	1	.50	4	4	.50
	(2)m	variants	f					variants	f		variants	f					variants	f		variants		f
t		Ø	1					Ø	1		d	1					Ø	1		Ø		3
																				d		1

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	4	7	.88	2	2	.50		0		1	1	.50	2	2	.50	2	2	.50	11	14	.64
t (2)f	variants	f		variants	f					variants	f		variants	f		variants	f		variants	f	
	Ø	4		?	2					k	1		Ø	2		Ø	2		Ø	8	
	?	3																	k	1	
																			?	5	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	18	18	1	16	16	1	15	15	1	10	10	1	16	16	1	5	5	1	80	80	1
(1)i	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	t	13		t	14		t	14		t	10		t	16		t	5		f	4	
	f	3		č	1		s	1											d	1	
θ	d	1		f	1														č	1	
	s	1																	s	2	
																			t	72	

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	10	10	1	7	7	1	12	12	1	9	9	1	5	5	1	9	9	1	52	52	1
(1)m	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	s	7		f	4		s	6		t	3		Ø	2		s	4		Ø	11	
	d	1		s	2		f	4		Ø	3		s	1		f	2		d	1	
	t	1		Ø	1		Ø	2		s	3		t	1		Ø	2		f	11	
	Ø	1											f	1		?	1		s	23	
																			t	5	
																			?	1	
θ																					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	8	8	1	5	5	1	8	8	1	3	3	1	4	4	1	3	3	1	31	31	1
(1)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	s	6		t	2		f	5		t	1		t	2		f	2		Ø	2	
	t	2		f	2		s	2		Ø	1		f	2		s	1		f	11	
				Ø	1		t	1		s	1								s	10	
																			t	8	

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	19	19	1	21	21	1	23	23	1	15	15	1	13	13	1	13	13	1	104	104	1
(1)i	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	d	19		d	21		d	23		d	14		d	13		d	13		Ø	1	
										Ø	1								d	103	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	4	4	1	2	2	1	1	1	1		0		1	1	1	1	1	1	9	9	1
(1)m	variants	f		variants	f		variants	f					variants	f		variants	f		variants	f	
	d	4		d	1		d	1					d	1		d	1		d	8	
				z	1														z	1	
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	16	16	1	13	13	1	16	16	1	7	7	1	13	13	1	8	8	1	73	73	1
(1)i	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	b	10		b	8		b	10		β	2		b	9		b	5		b	47	
	β	4		β	4		β	3		b	5		β	3		β	3		β	19	
	f	2		r	1		ℓ	1					w	1					f	2	
							m	1											ℓ	1	
							w	1											m	1	
																			r	1	
																			w	2	

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	18	18	1	10	10	1	11	11	1	5	5	1	4	4	1	4	4	1	52	52	1
(1)m	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
		ß	10		ß	7		ß	7		ß	4		ß	4		ß	4		Ø	1
		b	7		b	3		b	4		Ø	1								b	14
		w	1																	ß	36
																				w	1
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	18	18	1	21	21	1	12	12	1	11	11	1	13	13	1	13	13	1	88	88	1
(1)f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f	variants		f
		f	11		f	18		f	11		f	10		f	13		f	12		Ø	7
		Ø	4		ß	2		Ø	1		Ø	1					b	1		b	3
		b	2		Ø	1														ß	3
		ß	1																	f	75
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	1	1	1		0			0			0			0			0		1	1	1
w (1)i	variants		f																variants		f
		ß	1																	ß	1

Table 7 (cont'd)

Target	Grade																		Total Variants		
	1			2			3			4			5			6					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	11	11	1	4	4	1	6	6	1	4	4	1	6	6	1	8	8	1	39	39	1
(1)i	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants		f
	s	8		s	2		s	6		s	3		s	5		s	7		d		2
	d	1		g	1					v	1		d	1		ž	1		g		1
	dist	1		dist	1														ℓ		1
	ℓ	1																	s		31
																			v		1
																			ž		1
																			dist		2
(2)z																					
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	8	8	1	11	11	1	4	4	1		0		2	2	1	4	4	1	29	29	1
(1)m	variants	f		variants	f		variants	f					variants	f		variants	f		variants		f
	s	6		s	3		s	4					s	1		s	4		d		2
	ð	1		ð	5								d	1					s		18
	d	1		ž	2														ð		6
				dist	1														ž		2
																			dist		1

Table 7 (cont'd)

Target		Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Total Variants
		n f 5 5	n f 4 4	n f 2 2	n f 1 1	n f 9 9	n f 1 1	n f 22 22
br	r	variants f Ø 2 w 2 d 1	variants f Ø 3 w 1	variants f Ø 1 w 1	variants f Ø 1	variants f Ø 8 w 1	variants f w 1	variants f Ø 15 d 1 w 6
		n f 2 2	n f 0	n f 0	n f 0	n f 1 1	n f 0	n f 3 3
	d	variants f β 1 Ø 1				variants f b 1		variants f b 1 β 1 Ø 1
dr		n f 6 6	n f 1 1	n f 5 5	n f 1 1	n f 1 1	n f 0	n f 14 14
	r	variants f w 5 y 1	variants f w 1	variants f w 3 Ø 2	variants f Ø 1	variants f w 1		variants f Ø 3 w 10 y 1

Table 7 (cont'd)

Target	Grade																Total Variants		
	1			2			3			4			5			6				
	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf	n	f	rf
	24	81	.84	31	100	.81	33	113	.86	32	102	.80	31	96	.77	29	92	.79	180	584	.81
z (4)f	variants	f		variants	f		variants	f		variants	f		variants	f		variants	f		variants	f	
	s	73		s	99		s	112		s	102		s	94		s	91		Ø	7	
	Ø	5		dist	1		š	1					dist	1		Ø	1		s	571	
	t	1											Ø	1					š	1	
	dist	1																	t	1	
	θ	1																	θ	1	
																			dist	3	
	n	f		n	f		n	f		n	f		n	f		n	f				
	0			0			1	1		0			2	2		0			3	3		
bl l							variants	f					variants	f					variants	f		
							Ø	1					Ø	2					Ø	3		
	n	f		n	f		n	f		n	f		n	f		n	f				
	1	1		0			1	1		1	1		0			1	1		4	4		
b	variants	f					variants	f		variants	f					variants	f		variants	f		
br	d	1					Ø	1		Ø	1					Ø	1		Ø	3		
																			d	1		

Table 7 (cont'd)

Target	Grade 1	2	3	4	5	6	Total Variants
	n f	n f	n f	n f	n f	n f	n f
	1 1	1 1	0	0	0	0	2 2
f	variants f	variants f					variants f
	p 1	p 1					p 2
fℓ	n f	n f	n f	n f	n f	n f	n f
	0	1 1	1 1	0	0	2 2	4 4
ℓ		variants f	variants f			variants f	variants f
		w 1	∅ 1			w 1	∅ 2
						∅ 1	w 2
	n f	n f	n f	n f	n f	n f	n f
	1 1	0	0	0	0	0	1 1
gr r	variants f						variants f
	w 1						w 1

Table 7 (cont'd)

Target	Grade 1	2	3	4	5	6	Total Variants
	n f	n f	n f	n f	n f	n f	n f
	0	0	0	1 1	1 1	2 2	4 4
kℓ ℓ				variants f	variants f	variants f	variants f
				∅ 1	∅ 1	∅ 2	∅ 4
	n f	n f	n f	n f	n f	n f	n f
	1 1	0	0	0	0	0	1 1
k	variants f						variants f
	t 1						t 1
kr	n f	n f	n f	n f	n f	n f	n f
	3 3	3 3	1 1	2 2	3 3	0	12 12
r	variants f	variants f	variants f	variants f	variants f		variants f
	w 2	w 3	∅ 1	∅ 1	∅ 2		∅ 5
	∅ 1			w 1	w 1		w 7

Table 7 (cont'd)

Target	Grade 1	2	3	4	5	6	Total Variants
	n f	n f	n f	n f	n f	n f	n f
	0	0	0	0	1 1	0	1 1
p					variants f		variants f
					∅ 1		∅ 1
pℓ	n f	n f	n f	n f	n f	n f	n f
	2 2	0	0	0	2 2	1 1	5 5
ℓ	variants f				variants f	variants f	variants f
	∅ 1				∅ 2	w 1	∅ 3
	w 1						w 2
	n f	n f	n f	n f	n f	n f	n f
	3 3	0	0	0	1 1	0	4 4
s	variants f				variants f		variants f
	∅ 3				dist 1		∅ 3
skw							dist 1

Table 7 (cont'd)

Target	Grade 1	2	3	4	5	6	Total Variants
	n f	n f	n f	n f	n f	n f	n f
	13 13	8 8	7 7	6 6	4 4	4 4	42 42
w	variants f	variants f	variants f	variants f	variants f	variants f	variants f
skw	Ø 13	Ø 8	Ø 7	Ø 6	Ø 4	Ø 4	Ø 42
	n f	n f	n f	n f	n f	n f	n f
	3 3	1 1	0	0	1 1	0	5 5
s	variants f	variants f			variants f		variants f
	Ø 2	t 1			dist 1		Ø 2
	dist 1						t 1
							dist 2
sℓ	n f	n f	n f	n f	n f	n f	n f
	1 1	1 1	1 1	0	0	1 1	4 4
ℓ	variants f	variants f	variants f			variants f	variants f
	dist 1	t 1	w 1			Ø 1	Ø 1
							t 1
							w 1
							dist 1

Table 7 (cont'd)

Target	Grade						Total Variants	
	1	2	3	4	5	6		
	n f	n f	n f	n f	n f	n f	n f	
	0	0	1 1	0	1 1	1 1	3 3	
s			variants f		variants f	variants f	variants f	
			∅ 1		dist 1	dist 1	∅ 1	
							dist 2	
st	n f	n f	n f	n f	n f	n f	n f	
	1 1	0	0	0	0	0	1 1	
t	variants f						variants f	
	∅ 1						∅ 1	
	n f	n f	n f	n f	n f	n f	n f	
	1 1	0	0	0	0	0	1 1	
t	variants f						variants f	
tr	∅ 1						∅ 1	

Table 7 (cont'd)

Target	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5		Grade 6		Total Variants	
	n	f	n	f	n	f	n	f	n	f	n	f	n	f
tr	7	7	2	2	2	2	1	1	3	3	0		15	15
r	variants	f	variants	f	variants	f	variants	f	variants	f			variants	f
	w	6	w	2	Ø	2	w	1	Ø	2			Ø	5
	Ø	1							w	1			w	10
Total	585		481		451		326		390		304	=	2537	
Omissions	140		89		67		44		87		49	=	476	
Substitutions	437		388		381		279		297		252	=	2034	
Distortions	8		4		3		3		6		3	=	27	

*For each cell entry, n is the number of subjects who produced a variant for the row phoneme in the column grade; f is the number of variants produced; rf indicates the relative frequency of the total variants for each target (see Footnote 1, this section, for a detailed discussion of the rf figure.) The number of occurrences of each target on the Goldman-Fristoe test is indicated by the numeral to the left of that target's position indicator (i, m, or f). Each cell entry the observed variants are listed, with the number of occurrences of each. Omissions are indicated by the null sign, Ø.

Table 8

Variants Occurring in the Free Speech of Speakers of Mexican American English*

Target		Grade																								Total Variants			
		1				2				3				4				5				6							
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		5	12	21	.57	4	9	27	.34	3	3	18	.16	1	3	9	.33	8	24	63	.38	1	1	8	.12	22	52	146	.36
ɔ	m	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
		Ø			12	Ø			9	Ø			3	Ø			3	Ø			24	Ø			1	Ø			52
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		10	37	75	.49	13	35	143	.24	7	18	65	.27	2	6	10	.60	16	51	281	.18	5	13	68	.19	53	160	642	.25
	f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
		Ø			37	Ø			35	Ø			18	Ø			6	Ø			51	Ø			13	Ø			160
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		1	1	3	.34	2	2	10	.20		0			1	1	8	.12		0				0			4	4	21	.19
	i	variants			f	variants			f					variants			f									variants			f
b		β			1	β			1					β			1									β			3
						m			1																	m			1

Table 8 (cont'd)

Target	Grade 1	2	3	4	5	6	Total Variants
	n f o rf	n f o rf	n f o rf	n f o rf	n f o rf	n f o rf	n f o rf
	0	0	1 1 2 .50	0	2 2 2 1	0	3 3 4 .75
m			variants f		variants f		variants f
			v 1		p 1		β 1
					β 1		p 1
							v 1
b	n f o rf	n f o rf	n f o rf	n f o rf	n f o rf	n f o rf	n f o rf
	3 4 4 1	2 2 2 1	3 3 4 .75	0	0	0	8 9 10 .90
f	variants f	variants f	variants f				variants f
	p 4	p 2	p 3				p 9
	n f o rf	n f o rf	n f o rf	n f o rf	n f o rf	n f o rf	n f o rf
	2 2 3 .67	7 7 8 .87	4 4 7 .57	7 9 13 .69	3 3 3 1	3 3 3 1	26 28 37 .76
i	variants f	variants f	variants f	variants f	variants f	variants f	variants f
č	š 2	š 7	š 4	š 9	š 3	š 3	š 28

Table 8 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1	6	8	9	.88	6	8	8	1	4	4	6	.67	2	3	3	1	2	2	2	1	21	26	29	.90
m	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	s̆			1	s̆			8	s̆			8	s̆			4	s̆			3	s̆			2	s̆			26
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	7	9	9	1	12	15	16	.93	20	23	25	.92	4	4	6	.67	4	5	6	.83	4	5	5	1	51	61	67	.91
f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	s̆			9	s̆			15	s̆			23	s̆ dist			3 1	s̆			5	s̆			5	s̆ dist			60 1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				0				1	3	4	.75	0				0				0				1	3	4	.75
i									variants			f													variants			f
d									Ø			3													Ø			3

CSJ

Table 8 (cont'd)

Target		Grade 1				2				3				4				5				6				Total Variants			
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		2	2	2	1	1	1	2	.50	1	3	8	.37	3	3	6	.50	8	13	40	.32	8	13	44	.30	23	35	102	.34
m		variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
		t			1	Ø			1	Ø			2	Ø			1	Ø			7	Ø			8	Ø			19
		f			1					g			1	t			2	t			6	t			5	t			14
																										f			1
																										g			1
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		17	32	51	.62	12	19	57	.33	17	56	113	.49	23	54	112	.48	17	47	96	.49	21	61	130	.47	107	269	559	.48
d	f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
		t			19	t			9	t			45	Ø			14	Ø			8	Ø			7	t			205
		Ø			12	Ø			10	Ø			10	t			39	t			39	t			54	Ø			61
		?			1					š			1	?			1									?			2
																										š			1
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		1	1	3	.34	2	2	4	.50	1	2	2	1			0				0				0		4	5	9	.56
	i	variants			f	variants			f	variants			f													variants			f
f			p		1		β		1		p		2														p		3
							v		1																		β		1
																											v		1

Table 8 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	2	.50	2	2	2	1	2	2	3	.67		0				0				0			5	5	7	.71
f	variants			f	variants			f	variants			f													variants			f
f	č			1	β v			1 1	v			2													v β č			3 1 1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	2	3	4	.75	2	2	2	1	1	1	1	1	3	4	6	.67	1	1	1	1	2	2	2	1	11	13	16	.81
m	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	k			3	k			2	k			1	k			4	k			1	k			2	k			13
g	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	14	19	24	.79	4	4	8	.50	8	8	9	.88		0			5	5	6	.83	2	3	4	.75	33	39	51	.76
f	variants			f	variants			f	variants			f					variants			f	variants			f	variants			f
	k ʔ Ø			16 2 1	k			4	k Ø			7 1					k			5	k			3	k Ø ʔ			35 2 2

Table 8 (cont'd)

Target	Grade 1	2	3	4	5	6	Total Variants
i	n f o rf: 1 1 10 .10	0	0	0	0	1 1 3 .33	2 2 13 .15
	variants: d	f: 1				variants: d	f: 2
j	n f o rf: 0	2 2 3 .67	3 3 3 1	0	1 1 1 1	0	6 6 7 .86
	variants: Ø	f: 1	variants: y	f: 2	variants: ž	f: 1	variants: Ø / y / ž̌	f: 2 / 3 / 1
			y	1	Ø	1		
f	n f o rf: 1 1 1 1	5 5 5 1	0	2 2 3 .67	2 2 3 .67	2 2 2 1	12 12 14 .86
	variants: š̌	f: 1	variants: š̌ / ž̌ / č̌	f: 2 / 2 / 1	variants: ž̌ / š̌	f: 1 / 1	variants: š̌	f: 2	variants: š̌ / ž̌ / č̌	f: 7 / 4 / 1

Table 8 (cont'd)

Target	Grade																						Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	4	.25		0				0			1	1	5	.20		0				0			2	2	9	.22
i	variants			f									variants			f									variants			f
	t			1									h			1									h			1
																									t			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	4	.25		0			1	1	4	.25		0			2	2	14	.14		0			4	4	20	.20
k m	variants			f					variants			f					variants			f					variants			f
	Ø			1					Ø			1					Ø			1					Ø			3
																	g			1					g			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	3	.34		0			1	2	5	.40	2	2	4	.50	2	2	6	.33	1	3	4	.75	7	10	22	.45
f	variants			f					variants			f	variants			f	variants			f	variants			f	variants			f
	Ø			1					g			2	Ø			2	Ø			2	Ø			3	Ø			8
																									g			2

Table 8 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1			0				0				0				0				0		1	1	1	1
i	variants			f																					variants			f
	y			1																					y			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	2	.50	4	8	18	.44	1	1	3	.34	1	1	3	.33	5	8	26	.31	2	2	11	.18	14	21	63	.33
l m	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	Ø			1	Ø			8	Ø			1	Ø			1	Ø			8	Ø			2	Ø			21
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	18	23	54	.42	18	30	81	.37	10	33	51	.64	9	21	92	.23	18	63	148	.43	13	43	127	.34	86	213	553	.39
f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	Ø			15	Ø			29	Ø			33	Ø			21	Ø			62	Ø			42	Ø			202
	w			7	w			1									d			1	w			1	w			9
	?			1																					d			1
																									?			1

Table 8 (cont'd)

Target	Grade																						Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0				0			1	1	4	.25		0				0				0			1	1	4	.25
m									variants		f														variants		f	
									Ø		1														Ø		1	
m																												
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	2	3	.67		0				0			2	2	13	.15		0			2	4	16	.25	5	8	32	.25
f	variants		f										variants		f						variants		f		variants		f	
	p		1										Ø		2						Ø		4		Ø		7	
	Ø		1																						p		1	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	ri
		0				0			1	2	2	1		0				0				0			1	2	2	1
i									variants		f														variants		f	
n									d		2														d		2	

Table 8 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	2	8	.25		0			3	3	15	.20		0				0				0			4	5	23	.22
m	variants		f						variants		f														variants		f	
	Ø		2						Ø		3														Ø		5	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	6	7	116	.06	4	6	75	.08	1	1	6	.16		0			1	4	22	.18	3	7	79	.09	15	25	298	.08
f	variants		f		variants		f		variants		f						variants		f		variants		f		variants		f	
	Ø ?		6 1		Ø		6		Ø		1						Ø		4		Ø		7		Ø ?		24 1	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	6	.16	4	4	9	.44	3	3	11	.27		0				0				0			8	8	26	.31
i	variants		f		variants		f		variants		f														variants		f	
	β		1		b		4		b		3														b β		7 1	
p																												

Table 8 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	2	3	.67	1	1	3	.34		0				0				0				0			2	3	6	.50
m	variants			f	variants			f																	variants			f
		b		2		b		1																		b		3
p	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	2	6	6	1		0				0				0			1	2	3	.67		0			3	8	9	.89
f	variants			f													variants			f					variants			f
		Ø		6														Ø		2						Ø		8
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1	2	2	2	1	1	1	1	1		0			1	1	1	1	1	1	4	.25	6	6	9	.67
i	variants			f	variants			f	variants			f					variants			f	variants			f	variants			f
		w		1		w		2		w		1						w		1		w		1		w		6
r																												

Table 8 (cont'd)

Target		Grade																						Total Variants			
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		1	1	1	1			0		1	2	3	.67			0				0				0		2	3	4	.75
r	m	variants			f					variants			f													variants			f
			w		1						w		2														w		3
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		2	3	7	.42	2	6	11	.54			0				0		2	3	16	.19	2	2	16	.12	8	14	50	.28
	i	variants			f	variants			f									variants			f	variants			f	variants			f
		dist			2	θ			5									θ			1	t			2	θ			6
		č			1	dist			1									dist			2					dist			5
																										č			1
																										t			2
s		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		3	4	4	1	3	3	10	.30	1	1	1	1			0		2	10	10	1	1	1	7	.14	10	19	32	.59
	m	variants			f	variants			f	variants			f					variants			f	variants			f	variants			f
		Ø			3	θ			2	Ø			1					Ø			4	Ø			1	Ø			9
		θ				dist			1									dist			6					θ			3
																										dist			7

Table 8 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
s	5	8	12	.67	1	1	3	.34	3	3	41	.07		0			2	4	13	.31	2	4	15	.27	13	20	84	.24
	f	variants		f		variants		f		variants		f						variants		f		variants		f		variants		f
		Ø		4		dist		1		z		3						t		4		dist		4		dist		8
		dist		3																						z		3
		š		1																						t		4
																										Ø		4
																										š		1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	7	15	19	.78	13	29	58	.50	13	32	56	.57	23	55	120	.46	18	61	103	.59	15	47	74	.64	89	239	430	.56
i	variants			f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f
		č		15		č		28		č		32		č		54		č		60		č		46		č		235
š						t		1						s		1		t		1		t		1		t		3
																										s		1

0741

Table 8 (cont'd)

Target		Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		9	9	9	1	6	6	9	.67	7	10	13	.76	1	1	1	1	3	3	7	.43	1	1	1	1	27	30	36	.83
m		variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
		č			6	č			5	č			9	č			1	č			3	č			1	č			25
		d			1	dist			1	s			1													s			2
		s			1																					dist			2
		dist			1																					d			1
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		3	3	4	.75	5	5	8	.62	3	4	5	.80	5	8	9	.89	1	1	1	1		0			17	21	27	.78
f		variants			f	variants			f	variants			f	variants			f	variants			f					variants			f
		č			3	č			3	č			4	č			5	č			1					s			1
						s			1					z			2									č			16
						Ø			1					dist			1									ž			2
																										Ø			1
																										dist			1

Table 8 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0			1	1	5	.20		0				0			1	1	6	.17	1	1	11	.09	3	3	22	.14
i					variants		f										variants		f		variants		f		variants		f	
					Ø		1										Ø		1		Ø		1		Ø		3	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	2	8	.25	1	1	4	.25	1	1	6	.16	8	39	113	.34	4	11	32	.34	1	1	8	.12	16	55	171	.32
t m	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	Ø		2		Ø		1		Ø		1		Ø d		29 10		Ø		11		Ø		1		Ø d		45 10	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	17	47	161	.29	14	27	183	.14	8	19	135	.80	15	34	143	.24	11	30	151	.20	12	38	148	.27	77	195	921	.21
f	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	Ø ?		33 14		Ø ?		23 4		Ø ?		18 1		Ø ?		33 1		Ø		30		Ø ?		37 1		Ø ?		174 21	

Table 8 (cont'd)

Target	Grade																						Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	8	14	15	.93	11	21	32	.65	9	11	21	.52	10	23	31	.74	15	18	34	.53	11	25	35	.71	64	112	168	.67
i	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	t			14	t s			20 1	t			11	t s			22 1	t			18	t f d			22 2 1	t s f d			107 2 2 1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	7	8	13	.61	9	13	19	.68	15	22	27	.81	9	10	11	.91	10	12	16	.75	3	8	9	.89	53	73	95	.77
m	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	s t Ø			4 2 2	t s Ø č š			6 3 2 1 1	s t Ø f			16 4 1 1	t Ø s			8 1 1	t Ø			10 2	t s			7 1	s t Ø č š f			25 37 8 1 1 1

Table 8 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	14	29	53	.66	12	22	59	.37	15	47	66	.71	13	23	39	.59	13	19	27	.70	9	15	24	.62	76	155	268	.58
f	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	s		16		t		6		s		25		t		10		t		6		t		8		s		63	
	t		10		s		5		z		10		s		8		z		3		Ø		4		t		45	
	f		2		f		5		f		7		z		2		s		6		s		3		f		17	
	d		1		Ø		4		t		5		Ø		2		d		2						d		4	
					z		1						f		1		f		2						z		16	
					d		1																		Ø		10	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	20	153	201	.76	31	319	444	.71	31	385	614	.62	31	396	608	.65	32	343	567	.60	29	324	528	.61	174	1920	2962	.65
i	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	d		143		d		297		d		372		d		344		d		289		d		290		d		1735	
	Ø		10		Ø		22		Ø		9		Ø		52		Ø		53		Ø		34		Ø		180	
									t		3						t		1						t		4	
									z		1														z		1	

Table 8 (cont'd)

Target		Grade 1				2				3				4				5				6				Total Variants			
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		4	11	23	.47	5	5	26	.19	2	2	4	.50	2	3	10	.30	6	16	29	.55	3	4	16	.25	22	41	108	.38
ox	m	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
		d		10		d		3		Ø		2		Ø		3		Ø		15		Ø		3		Ø		26	
		Ø		1		Ø		2										d		1		θ		1		d		14	
																										θ		1	
		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0				0				1	1	1	1	1	2	2	1	1	1	1	1	2	3	3	1	5	7	7	1
	i									variants		f		variants		f		variants		f		variants		f		variants		f	
										β		1		β		2		b		1		b		2		β		4	
																						β		1		b		3	
v		n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		3	3	8	.37	3	6	8	.75	7	9	17	.52	5	7	18	.39	11	17	32	.53	6	11	19	.58	35	53	102	.52
	m	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
		b		2		β		3		Ø		4		f		4		f		8		f		6		β		14	
		β		1		Ø		3		f		3		Ø		3		β		6		β		2		b		2	
										β		2						Ø		3		Ø		3		f		21	
																										Ø		16	

Table 8 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	3	.34	1	1	1	1			0				0		3	3	3	1			0		5	5	7	.71
m	variants			f	variants			f									variants			f					variants			f
		d		1		s		1										s		3						s		4
																										d		1
z	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	26	222	297	.74	29	265	601	.44	32	433	691	.62	32	433	784	.55	30	438	756	.58	32	556	817	.68	181	2347	3946	.59
f	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	s		188		s		253		s		429		s		432		s		424		s		555		s		2281	
	Ø		12		Ø		11		Ø		4		Ø		1		Ø		5		Ø		1		Ø		34	
	?		12		dist		1										dist		4						dist		13	
	dist		8														t		5						?		12	
	d		2																						t		5	
																									d		2	

Table 8 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
v	7	16	22	.72	7	16	25	.64	6	9	15	.60	5	6	14	.43	10	12	44	.27	7	13	23	.57	42	72	143	.50
f	variants		f		variants		f		variants		f		variants		f		variants		f		variants		f		variants		f	
	f		10		Ø		8		f		7		Ø		4		f		9		f		8		f		42	
	Ø		4		f		6		Ø		2		f		2		Ø		3		Ø		5		Ø		26	
	b		1		β		2																		β		2	
	ð		1																						b		1	
																									ð		1	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				1	1	2	.50	0				0				0				1	2	2	1	2	3	4	.75
y i					variants		f														variants		f		variants		f	
					ǰ		1														ǰ		2		ǰ		3	
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				2	2	2	1	0				0				0				0				2	2	2	1
i					variants		f																		variants		f	
z					s		1																		s		1	
					dist		1																		dist		1	

Table 8 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0				0				0				0				0			1	1	3	.33	1	1	3	.33
b																					variants			f	variants			f
																					Ø			1	Ø			1
br																												
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1	4	8	10	.80	4	6	9	.67		0			10	16	21	.76	1	1	3	.33	20	32	44	.73
r	variants			f	variants			f	variants			f					variants			f	variants			f	variants			f
	w			1	Ø			7	Ø			5					Ø			16	Ø			1	Ø			29
					w			1	w			1													w			3
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1	2	2	2	1	1	1	1	1		0				0				0			4	4	4	1
d	variants			f	variants			f	variants			f													variants			f
	b			1	Ø			1	j			1													b			1
dr					g			1																	g			1
																									j			1
																									Ø			1

Table 8 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
dr	2	3	3	1	2	3	4	.75	3	4	5	.80			0		1	1	1	1			0		8	11	13	.85
r	variants			f	variants			f	variants			f					variants			f					variants			f
	w Ø			2 1	w			3	Ø w			3 1					Ø			1					w Ø			6 5
fl l	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	0				1	1	2	.50	0				0				0				0				1	1	2	.50
					variants			f																	variants			f
					Ø			1																	Ø			1
fr r	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1	0				0				0				0				0				1	1	1	1
	variants			f																					variants			f
	Ø			1																					Ø			1

Table 8 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0				0				0				0			2	2	6	.33		0			2	2	6	.33
gr r																	variants			f					variants			f
																		w		2						w		2
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0			1	2	15	.13		0				0			2	3	4	.75		0			3	5	19	.26
kl l					variants			f									variants			f					variants			f
						Ø		2										Ø		3						Ø		5
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0			1	1	1	1		0				0				0				0			1	1	1	1
kr r					variants			f																	variants			f
						w		1																		w		1

637.29

Table 8 (cont'd)

Target	Grade 1				2				3				4				5				6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1			0				0				0				0						1	1	1	1
pl	variants			f																					variants			f
	Ø			1																					Ø			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0			1	1	1	1		0				0				0				0			1	1	1	1
s					variants			f																	variants			f
					θ			1																	θ			1
skw	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	5	6	6	1	3	3	3	1	3	3	3	1		0				0				0			11	12	12	1
w	variants			f	variants			f	variants			f													variants			f
	Ø			6	Ø			3	Ø			3													Ø			12

Table 8 (cont'd)

Target	Grade																								Total Variants			
	1				2				3				4				5				6							
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	2	3	4	.75	1	1	1	1			0				0				0				0		3	4	5	.80
s	variants			f	variants			f																	variants			f
	θ			1	Ø			1																	f			2
	f			2																					θ			1
																									Ø			1
sℓ	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	3	.33		0				0				0				0				0			1	1	3	.33
ℓ	variants			f																					variants			f
	Ø			1																					Ø			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	3	3	4	.75		0				0				0				0				0			3	3	4	.75
sp s	variants			f																					variants			f
	Ø			2																					Ø			2
	dist			1																					dist			1

Table 8 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1		0				0				0			1	1	1	1		0			2	2	2	1
s	variants			f													variants			f					variants			f
		Ø		1														dist		1						Ø		1
																										dist		1
st	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	3	3	5	.60		0				0				0				0				0			3	3	5	.60
t	variants			f																					variants			f
		Ø		3																						Ø		3
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	3	3	3	1	1	1	2	.50		0				0				0				0			4	4	5	.80
s	variants			f	variants			f																	variants			f
str		Ø		3		Ø		1																		Ø		4

Table 8 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	1	1			0				0				0				0				0		1	1	1	1
t	variants			f																					variants			f
	θ			1																					θ			1
str																												
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	2	2	2	1	2	2	3	.67			0				0				0				0		4	4	5	.80
r	variants			f	variants			f																	variants			f
	∅			2	∅			1																	∅			3
					w			1																	w			1
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
		0			1	1	1	1	1	1	1	1		0			1	1	1	1		0			3	3	3	1
tr r					variants			f	variants			f					variants			f					variants			f
					w			1	∅			1					∅			1					∅			2
																									w			1

Table 8 (cont'd)

Target	Grade 1				Grade 2				Grade 3				Grade 4				Grade 5				Grade 6				Total Variants			
	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	4	5	6	.83	5	5	6	.83	1	1	2	.50	8	12	18	.67	7	8	11	.73	7	8	9	.89	32	39	52	.75
θ	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f	variants			f
	t dist			3 2	t			5	t			1	t			12	t			8	t			8	t dist			37 2
θr	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf	n	f	o	rf
	1	1	2	.50	1	1	1	1		0				0				0				0			2	2	3	.67
r	variants			f	variants			f																	variants			f
	Ø			1	dist			1																	Ø dist			1 1

Totals	760	948	1193	1169	1274	1232	= 6576
Omissions	188	194	132	178	313	179	= 1184
Substitutions	555	747	1061	989	949	1049	= 5350
Distortions	17	7	0	2	12	4	= 42

* For each cell n is the number of children in the column grade who produced a variant of the row target phoneme. The number of occurrences of the target phoneme in the speech samples from that grade is indicated by the o value, and the number of variations produced is indicated by the f value. Relative frequency (rf) is obtained by dividing f by o. In the lower part of each cell, the type of variant and the number of occurrences of each is noted.

Table 9

Summary of Frequencies and Feature Changes for Those Variants Produced by Speakers of MAE on the Goldman-Fristoe Test with a Frequency Greater than Five

Target*	Position	Over-all Frequency of Variation of Target	Individual Variants	Frequency of Individual Variants	Change in +/- Features	Change in M/U Features
z (214)	i	39	s	31	-voi	U voi
	m	29	s	18	-voi	U voi
	f	146	s	142.75	-voi	U voi
v (213)	i	73	b	47	-str -cnt	M cor U cnt U str
			β	19	+dist**	M dist
	m	52	b	14	-str -cnt	M cor U cnt U str
			β	36	+dist	M dist
	f	88	f	75	-voi	U voi
			omit	7		

Table 9 (cont'd)

Target	Position	Over-all Frequency of Variation of Target	Individual Variants	Frequency of Individual Variants	Change in +/- Features	Change in M/U Features
č (209)	i	61	š	54.5	+cnt	M cnt
			t	2	+ant -str	U ant U cor U str
	m	66	š	59	+cnt	M cnt
			t	4	+ant -str	U ant U cor U str
	f	82	š	79	+cnt	M cnt
			t	1	+ant -str	U ant U cor U str
š (184)	i	79	č	75	-cnt	U cnt
	m	43	č	42	-cnt	U cnt
	f	62	č	57	-cnt	U cnt

Table 9 (cont'd)

Target	Position	Over-all Frequency of Variation of Target	Individual Variants	Frequency of Individual Variants	Change in +/- Features	Change in M/U Features
	i	80	t	72	-cnt	U cor U cnt U str
	m	52	s	23	+str	U cor U str
			d	11	-cnt +voi	U cor U cnt U str M voi
	θ (163)		omit	11		
			t	5	-cnt	U cor U cnt U str
	f	31	f	11	-cor +str	U cor
			s	10	+str	U cor U str
			t	8	-cnt	U cor U cnt U str

Table 9 (cont'd)

Target	Position	Over-all Frequency of Variation of Target	Individual Variants	Frequency of Individual Variants	Change in +/- Features	Change in M/U Features
ʒ (113)	i	104	d	103	-cnt	U cor U cnt U str
	m	9	d	8	-cnt	U cor; U cnt U str
d (89)	f	89	t	82	-voi	U voi
			omit	7		
	m	14	d	7	+ant -str	U ant U cor U str
ǰ (75)	f	61	č	52	-voi	U voi
			š	5	+cnt -voi	M cnt U voi
g (64)	f	64	k	58	-voi	U voi
b (62)	f	62	p	58	-voi	U voi
ɫ (52.33)	f	52.33	omit	49		

Table 9 (cont'd)

Target	Position	Over-all Frequency of Variation of Target	Individual Variants	Frequency of Individual Variants	Change in +/- Features	Change in M/U Features
r (21.5)	i	15	w	12.5	-cns -voc -ant -cor -lat	-cns
ð (20.05)	m	5.25	omit	5.25		
	f	14.80	omit	14.74		
p (8.5)	f	8.5	omit	8.5		
n (8)	f	8	omit	7.8		

*Target phonemes are rank ordered according to frequency of variants associate with each. The total frequency associated with each target appears in parentheses below the target symbol; however, only those variants are reported which had a frequency of greater than five. All frequencies are adjusted frequencies if the target appeared more than once in the Goldman-Fristoe test (see Footnote 2, this section, for a detailed discussion of the adjusted frequency figure).

**The feature which distinguishes /β/ from /v/ is "distributed" (dist), a feature which does not distinguish any phonemes of English from each other, thus is not a distinctive feature of English. The feature "distributed" refers to the length of the constriction associated with a fricative -- a sound which is [+dist] (such as /β/) has a longer constriction than does a sound (such as /v/) which is [-dist]

Table 10

Relationships Among Goldman-Fristoe (G-F) and Free Speech (F-S)

Variant*		Variants in MAE Group			
		Produced Variant on G-F, but not on F-S		Produced Variant on both G-F and F-S	Produced Variant on F-S, but not on G-F
	n**	N/V***	N/O****		
/t/ for /θ/ (i)	104	10 .10	32 .31	30 .29	32 .31
/t/ for /θ/ (m)	29	0 0	3 .10	1 .03	25 .86
/t/ for /θ/ (f)	37	5 .14	1 .03	3 .08	28 .76
/s/ for /θ/ (i)	4	1 .25	1 .25	0 0	2 .50
/s/ for /θ/ (m)	39	5 .13	11 .28	6 .15	17 .44
/s/ for /θ/ (f)	41	1 .02	3 .07	6 .15	31 .76
/f/ for /θ/ (i)	6	3 .50	1 .17	0 0	2 .33
/f/ for /θ/ (m)	12	2 .17	9 .75	0 0	1 .08
/f/ for /θ/ (f)	17	4 .24	2 .12	5 .29	6 .35

Table 10 (cont'd)

Variant	n	Produced Variant on G-F, but not on F-S		Produced Variant on both G-F and F-S	Produced Variant on F-S, but not on G-F
		N/V	N/O		
/d/ for /ð/	177	4	0	98	75
(i)		.02	0	.55	.42
/f/ for /v/	2	0	2	0	0
(i)		0	1.00	0	0
/f/ for /v/	16	0	0	0	16
(m)		0	0	0	1.00
/f/ for /v/	85	29	27	19	10
(f)		.34	.32	.22	.12
/β/ + /b/ for /v/	67	4	58	4	1
(i)		.06	.87	.06	.01
/β/ + /b/ for /v/	57	22	23	5	7
(m)		.39	.40	.09	.12
/β/ + /b/ for /v/	8	4	1	1	2
(f)		.50	.13	.13	.25
/s/ for /z/	33	1	31	0	1
(i)		.03	.94	0	.03
/s/ for /z/	22	3	14	1	4
(m)		.14	.64	.05	.18

Table 10 (cont'd)

Variant	n	Produced Variant on G-F, but not on F-S		Produced Variant on both G-F and F-S	Produced Variant on F-S, but not on G-F
		N/V	N/O		
/s/ for /z/	183	4	0	175	4
(f)		.02	0	.96	.02
/š/ for /č/	84	8	51	19	6
(i)		.10	.61	.23	.07
/š/ for /č/	71	2	48	9	12
(m)		.03	.68	.13	.17
/š/ for /č/	95	7	34	38	16
(f)		.07	.36	.40	.17
/č/ for /š/	113	16	10	46	41
(i)		.14	.09	.41	.36
/č/ for /š/	54	15	16	11	12
(m)		.28	.30	.20	.22
/č/ for /š/	58	14	29	12	3
(f)		.24	.50	.21	.05
/č/ for /ǰ/	54	3	47	2	2
(f)		.06	.87	.04	.04
/p/ for /b/	62	4	47	6	5
(f)		.07	.76	.10	.08
/t/ for /d/	119	19	10	46	44
(f)		.16	.08	.39	.37

Table 10 (cont'd)

Variant		Produced Variant on G-F, but not on F-S		Produced Variant on both G-F and F-S	Produced Variant on F-S, but not on G-F
	n	N/V	N/O		
/k/ for /g/	70	13	29	15	13
(f)		.19	.41	.21	.19
Omit /ℓ/	97	8	0	78	11
(f)		.08	0	.80	.11

*Substitution variants are indicated by noting that one phoneme was produced 'for' another. Position of the variant is indicated in parentheses below the specification of the variant. Thus, the first row indicates the substitution of /p/ for /b/ in final position.

**n indicates the number of subjects who produced the indicated variant on either Goldman-Fristoe or in Free Speech.

***N/V indicate the number (and proportion) of subjects who produced the target phoneme in Free Speech, but did not produce the indicated variant.

****N/O indicates the number and proportion of subjects whose Free Speech sample did not include the target phoneme (thus, there was, for these subjects, no opportunity to produce the variant).

the subjects in the case of the /t/ for /θ/ substitution in medial and final positions, the /s/ for /θ/ substitutions in initial and final positions, and the /f/ for /v/ substitution in medial position. Thus, every prediction error of a 50% magnitude or greater involved either the /θ/ or /v/ target phonemes. By contrast, recall that six targets recorded this magnitude of misprediction in the Niagara Falls sample. (See Section 4.1.3.)

4.2.4. The frequency distributions of individual variants across grades. It was impossible to discover for the Mexican American subjects clearly describable dialect vs. developmental patterns of frequency distributions across grades as was revealed in the Niagara Falls sample.

Since there seem to be no empirical or linguistic grounds for grouping any of the target phonemes together, they are displayed in individual graphs in Figures 6 through 16. The 11 target phonemes (see Table 9) which most frequently produced variants are represented in the graphs. Chi Square tests were used to ascertain the degree to which each frequency distribution across grades differed from chance. No χ^2 is reported which has a probability value greater than .10. Where appropriate the ordinate represents adjusted frequencies (see footnote 2). The information contained in the figures is the following:

Figure 6: This graph shows the distribution of all variants (in all positions) of the target phoneme /θ/. Variants of /θ/ in general decrease across grade levels. χ^2 for this distribution = 10.1, p = .07.

Figure 7: This graph shows the distribution of the three most common variants of the /θ/ phoneme -- the substitution of /t/, /s/, and /f/. The frequency distribution of the /t/ for /θ/ substitution, which does not differ from chance, is relatively flat except for a dip at the sixth grade. The /s/ for /θ/ distribution has a χ^2 of 20.4, p = .002, and the /f/ for /θ/ substitution has a χ^2 = 11.8, p = .04. Even though the statistics show the latter two substitutions to be distributed differently from what would be expected by chance, the pattern of the distributions do not seem to indicate any overall trends.

Figure 8: In this figure the distribution of the /d/ for /ð/ substitution is displayed for the two positions in which /ð/ occurs in English, initial and medial. Chi Square tests show that neither of these distributions differ significantly from chance, but inspection of the graphs reveal a definite decreasing trend in the incidence of the /d/ for /ð/ substitution in initial position across grades.

Figure 6

Incidence of Variants Associated with the Target Phoneme /θ/ by Grade for the MAE Group

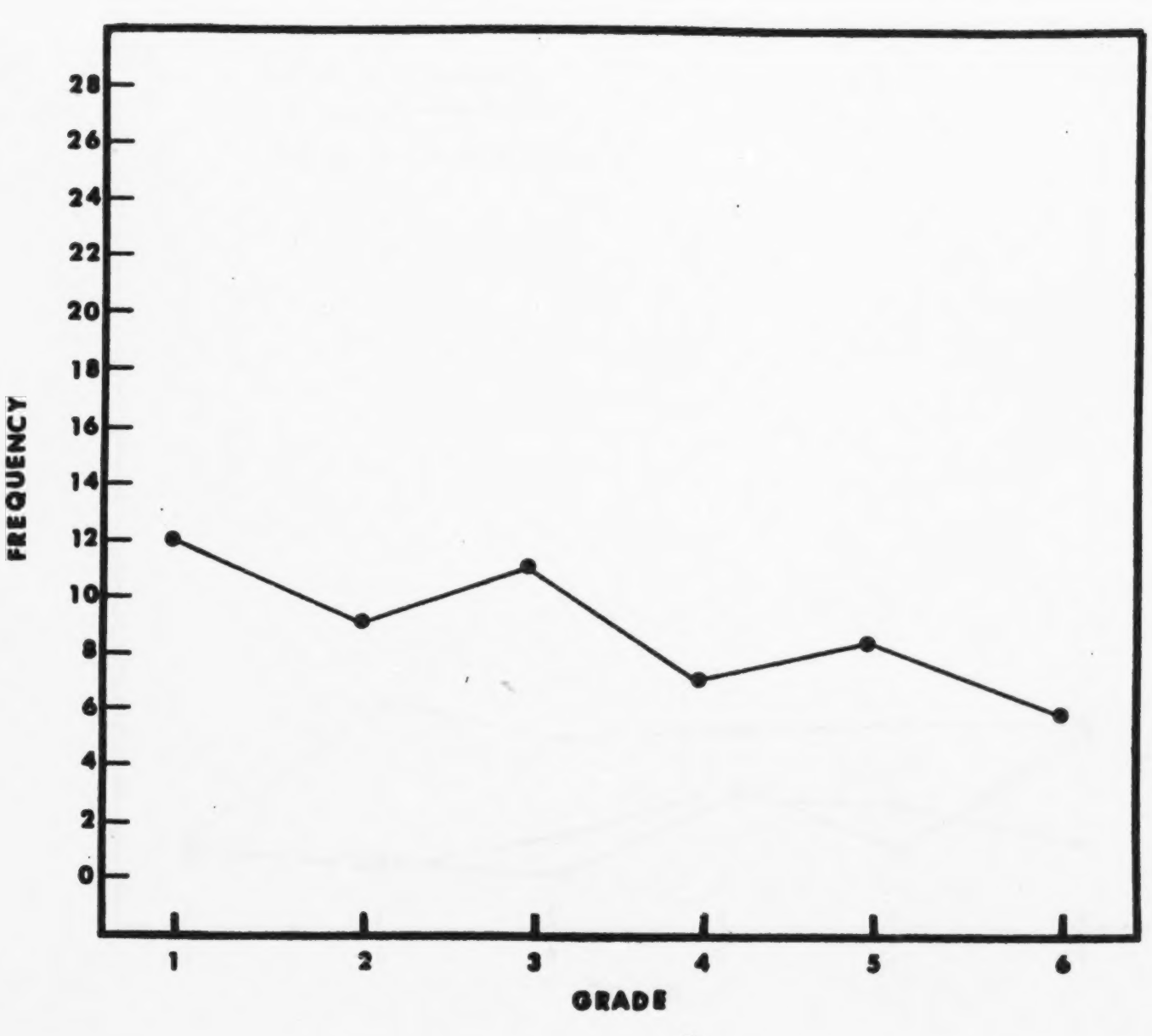


Figure 7

Incidence of /t/, /s/, and /f/ Substitutions for /θ/
by Grade for MAE Group

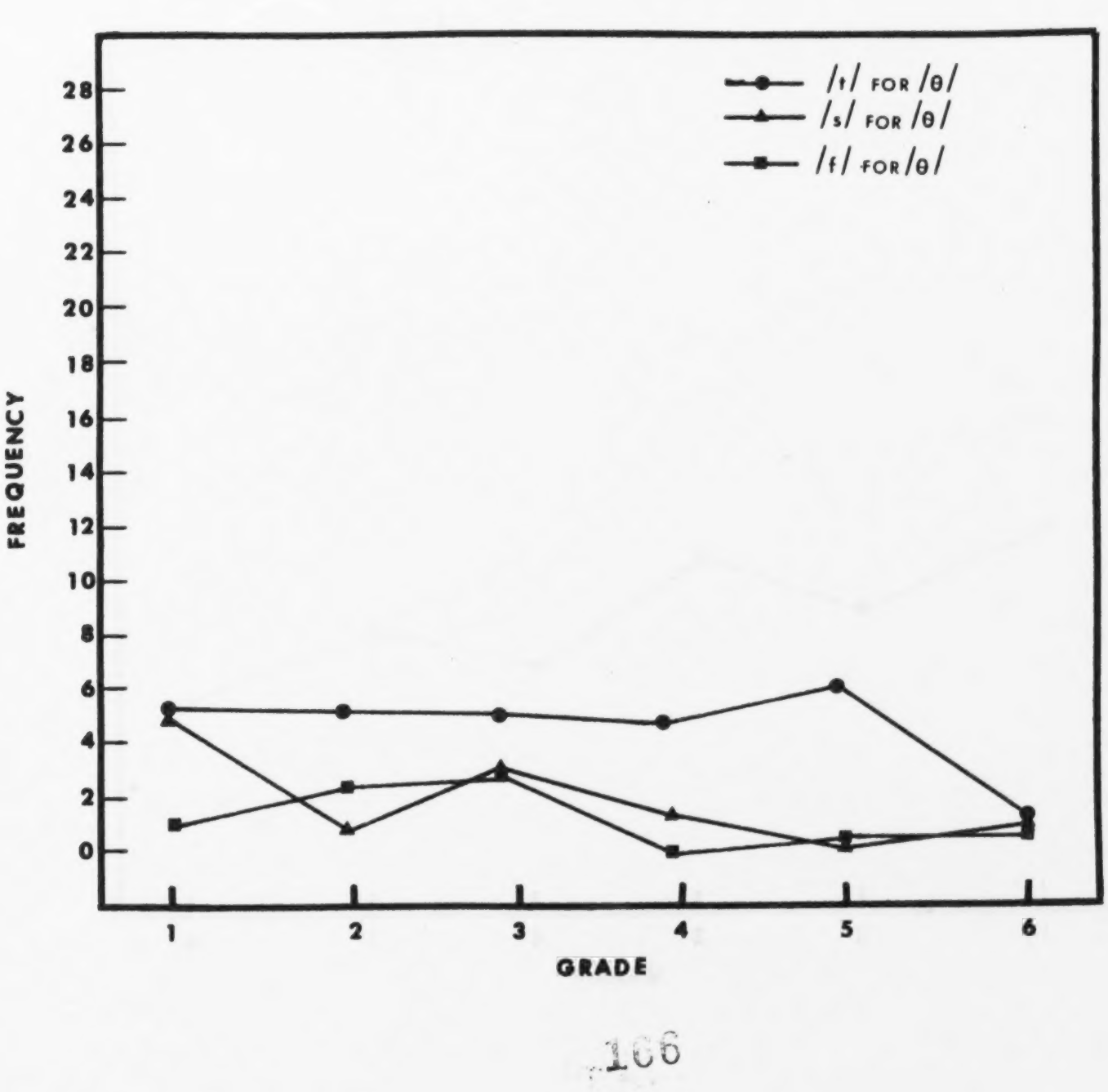


Figure 8

Incidence of /d/ for /ð/ Substitutions in Initial and Medial Positions by Grade for MAE Group

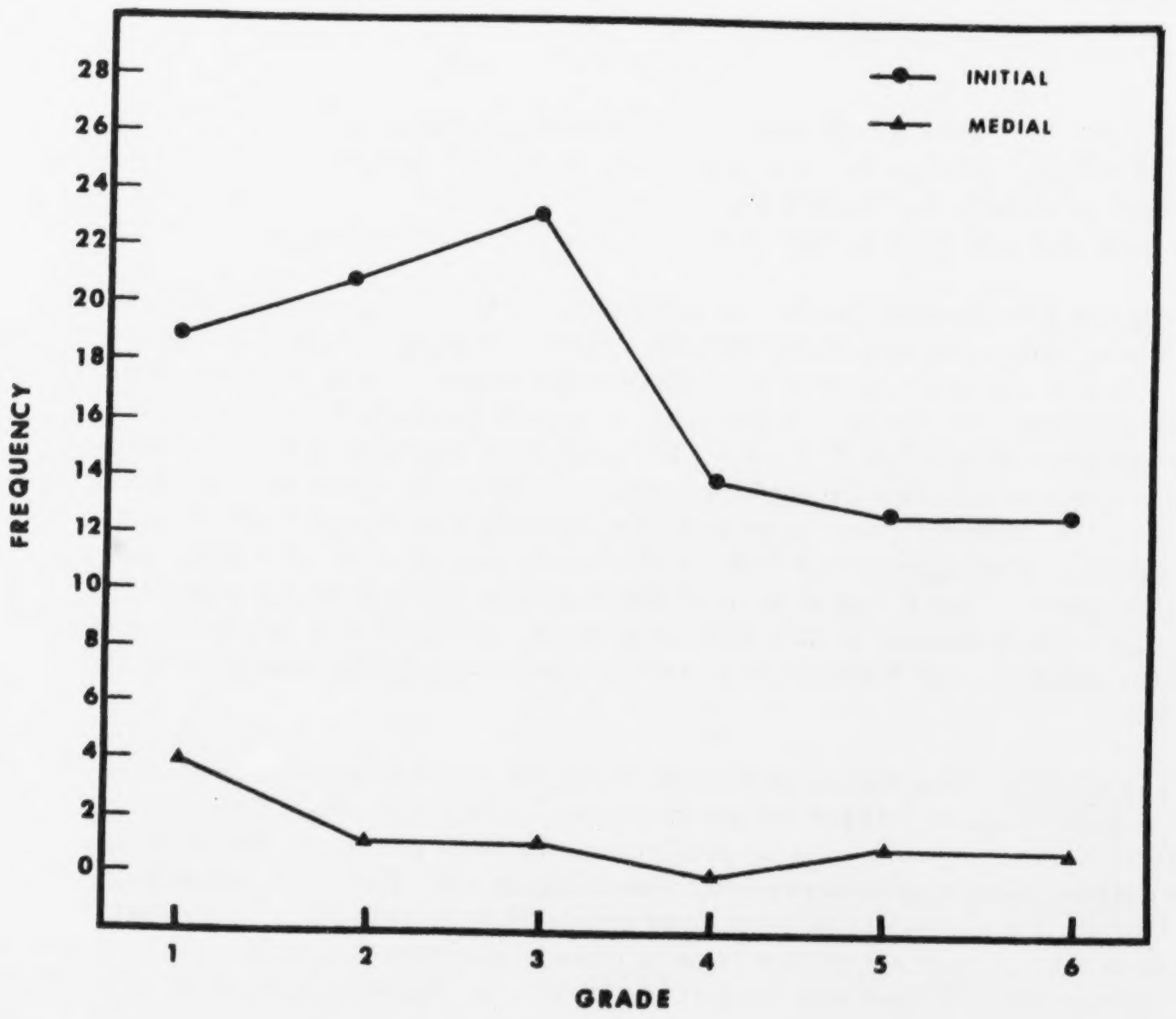


Figure 9: This figure presents the incidence of the omission of final /ℓ/ across grades. A χ^2 of 17.5, p = .004, partially reflects the erratic increase in omissions in the fifth grade group. There is, however, a general decrease across the other grades.

Figure 10: The frequency of devoicing of final /d/ (/t/ for /d/ substitution) is shown in this figure. The χ^2 of 9.9, p = .08, reflects an erratic U-shaped distribution.

Figure 11: The devoicing of final /g/ (/k/ for /g/ substitution) shows a completely different pattern than the U-shaped distribution of /t/ for /d/. There is a definite overall decrease across grades. χ^2 for this distribution = 10.3, p = .07.

Figure 12: The devoicing of final /b/ (/p/ for /b/ substitution) shows a pattern similar to that of the devoicing of /d/ in that the increase in fifth grade gives the curve a slight U-shaped appearance. It is also, however, similar to the distribution of final /g/ devoicing in that except for the increase in fifth grade, there is a general decrease in frequency of devoicing.

Figure 13: This graph presents devoicing of final /ǰ/, the /č/ for /ǰ/ substitution. Except for a low frequency in first grade, incidence of this variant generally decreases across grades. The χ^2 of 9.4, p = .09 reflects both the low first grade frequency and the overall trend.

Figure 14: In this figure the devoicing of /z/ is graphed, both in final position and in combined initial and medial positions. (Recall that all frequencies are adjusted so that they are comparable to each other.) The devoicing of final /z/ is by far the most frequent variant found in the San Antonio sample. The χ^2 of 9.0, p = .10, probably reflects the increase in frequency associated with the middle grades. Although there is a decreasing trend in the later grades, note that the frequency remains higher than in first grade. The opposite is true of the devoicing of /z/ in initial and medial positions. The χ^2 of 9.8, p = .08, for this distribution reflects a general dip in frequencies in the middle grades. While there is an increase in the later grades, the final sixth grade frequency is lower than that of the first grade.

Figure 15: This figure presents variants associated with /v/, the second most frequently varied target phoneme in San Antonio. Two types of variants of /v/ were typically produced. In final position, the familiar devoicing phenomenon was observed, resulting in /f/ for /v/ substitutions. Except for an increase in second grade this distribution is almost flat, and, in fact, does not differ from a chance distribution. The variant of /v/ observed in initial and medial positions, is the substitution of

Figure 9

Incidence of Omission of Final /ℓ/ by
Grade for MAE Group

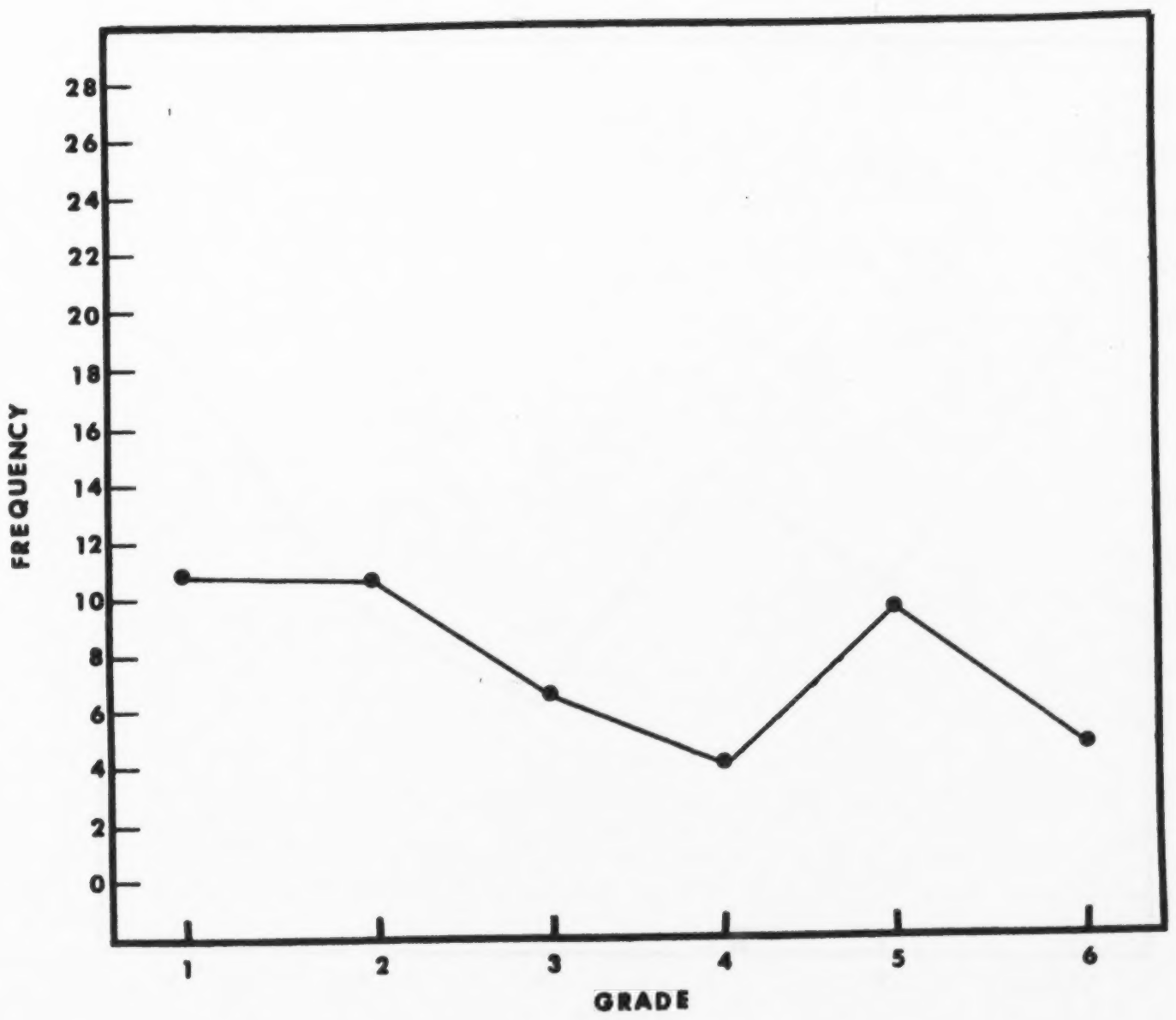


Figure 10

Incidence of /t/ for /d/ Substitution in Final Position by Grade in MAE Group

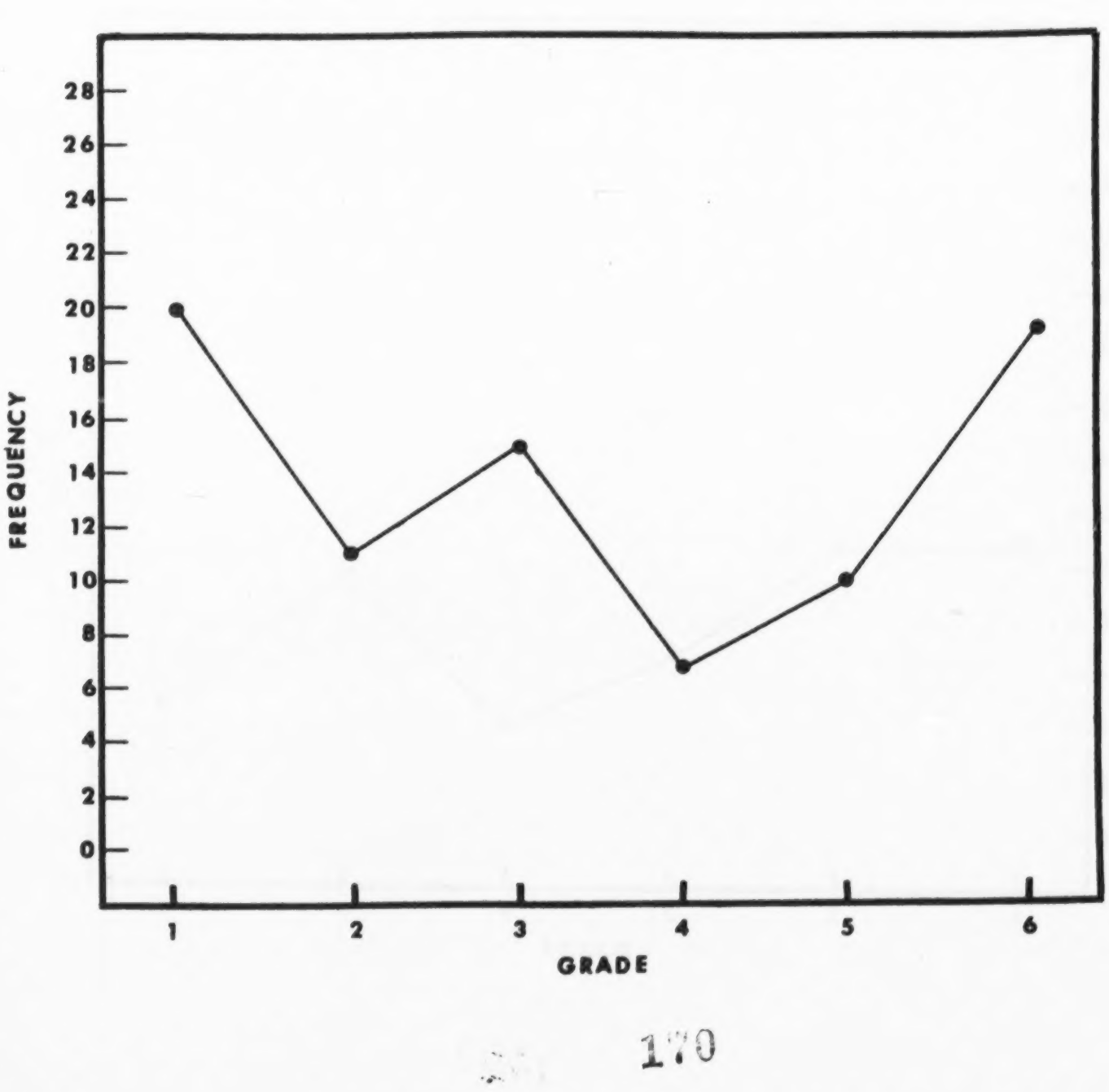


Figure 11

Incidence of /k/ for /g/ Substitution in Final Position by Grade for MAE Group

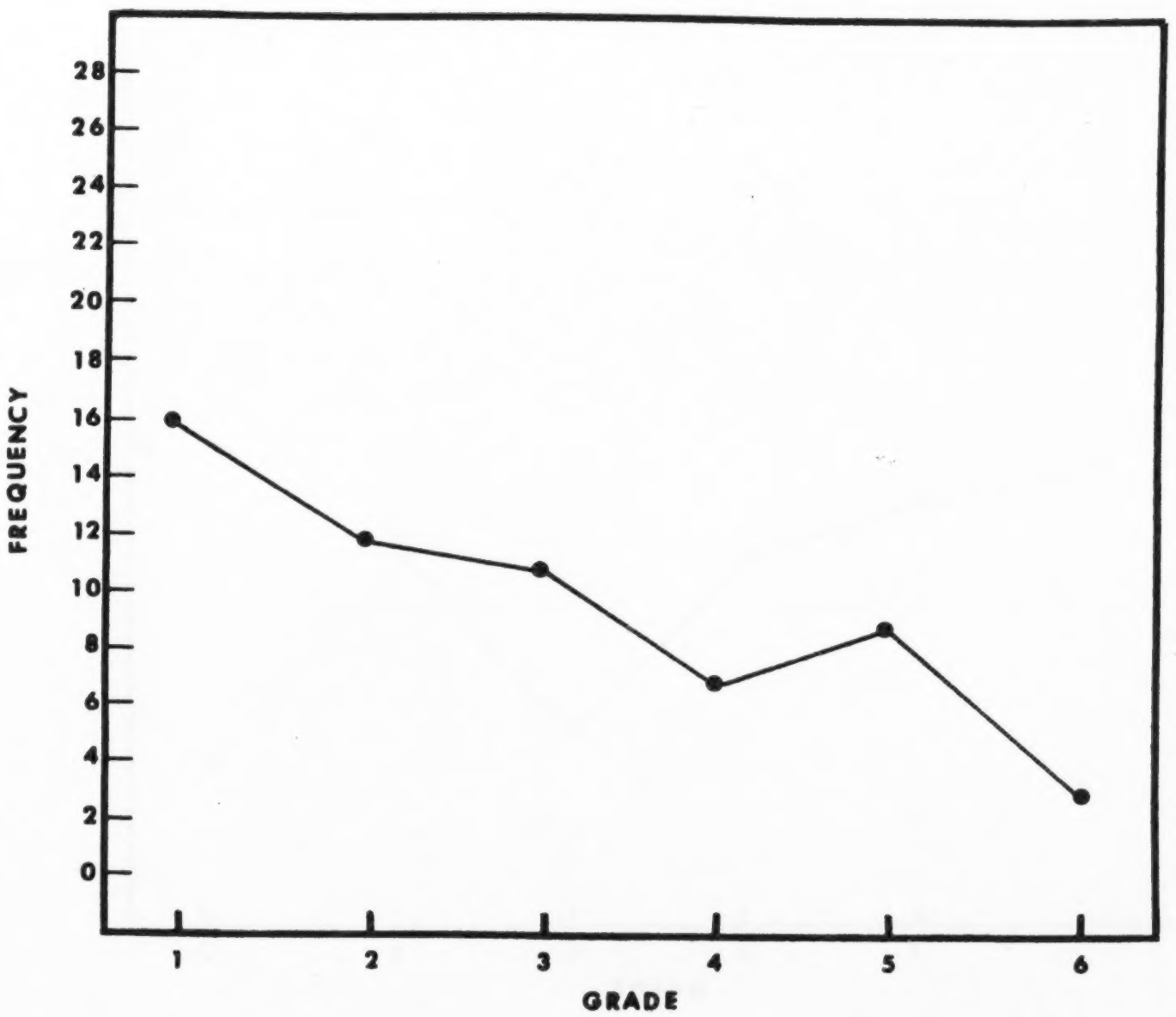


Figure 12

Incidence of /p/ for /b/ Substitution in Final Position by Grade in MAE Group

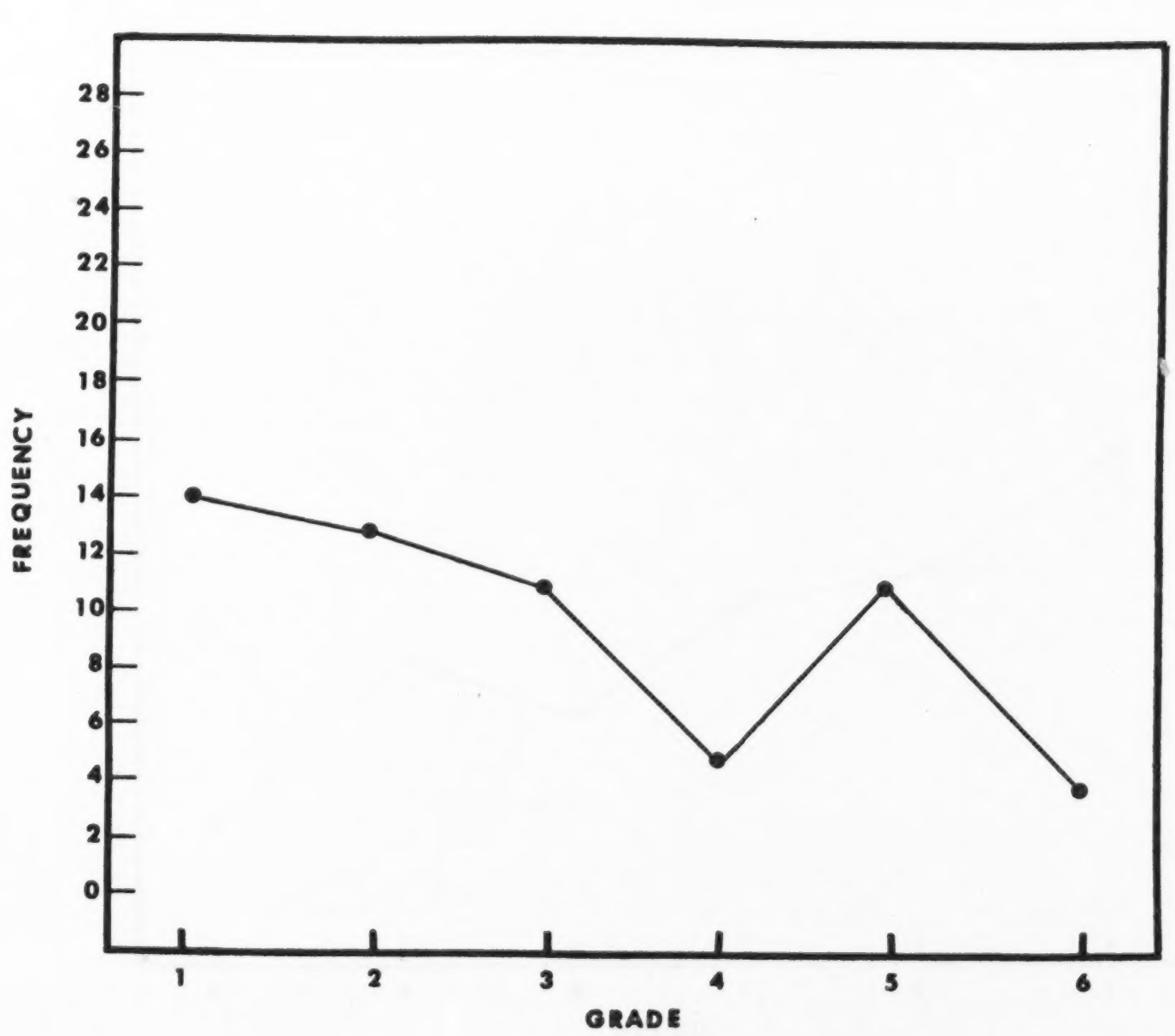


Figure 13

Incidence of /č/ for /ǰ/ Substitution in Final Position by Grade for MAE Group

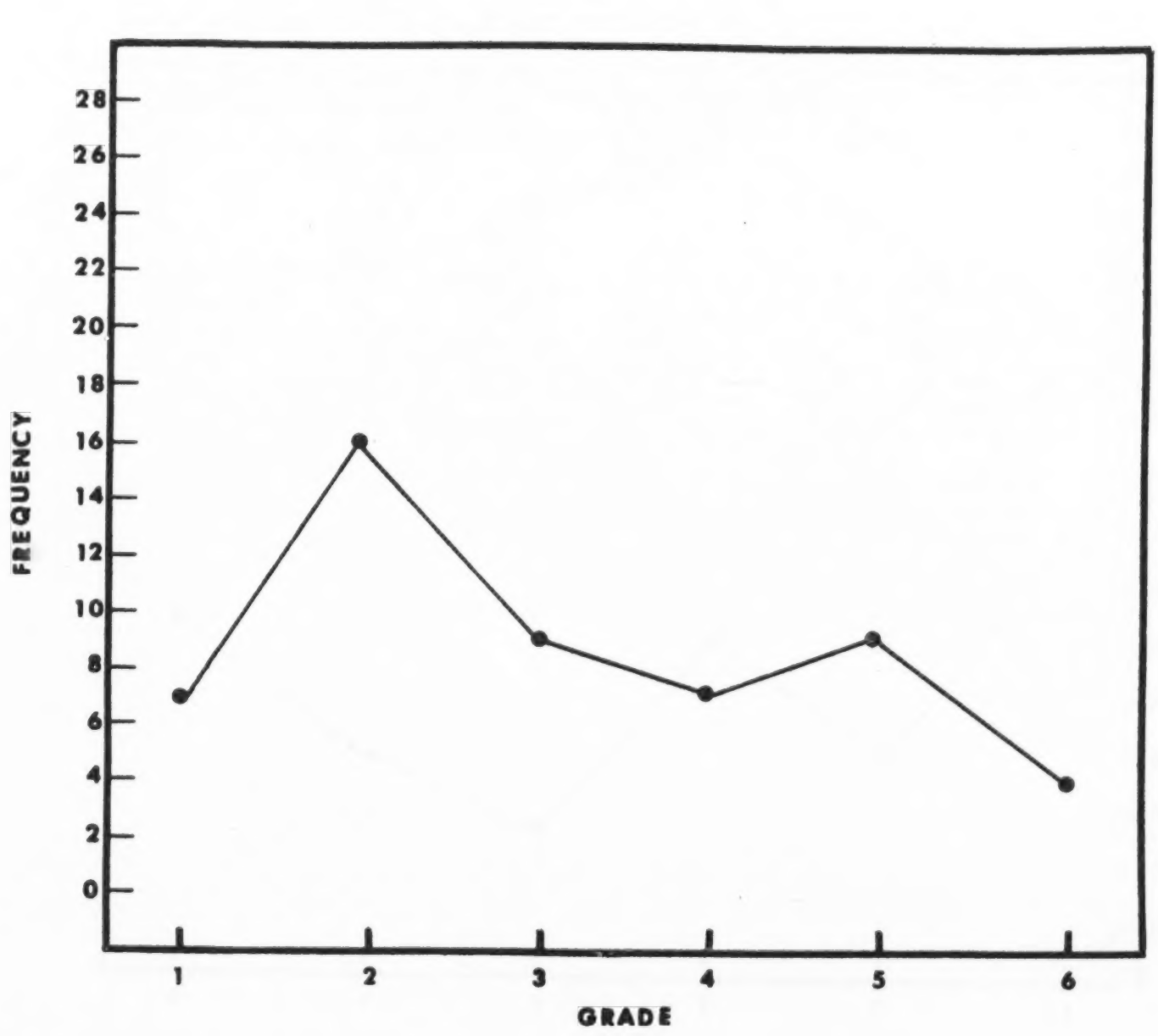


Figure 14

Incidence of /s/ for /z/ Substitution Initial + Medial Position and in Final Position by Grade for MAE Group

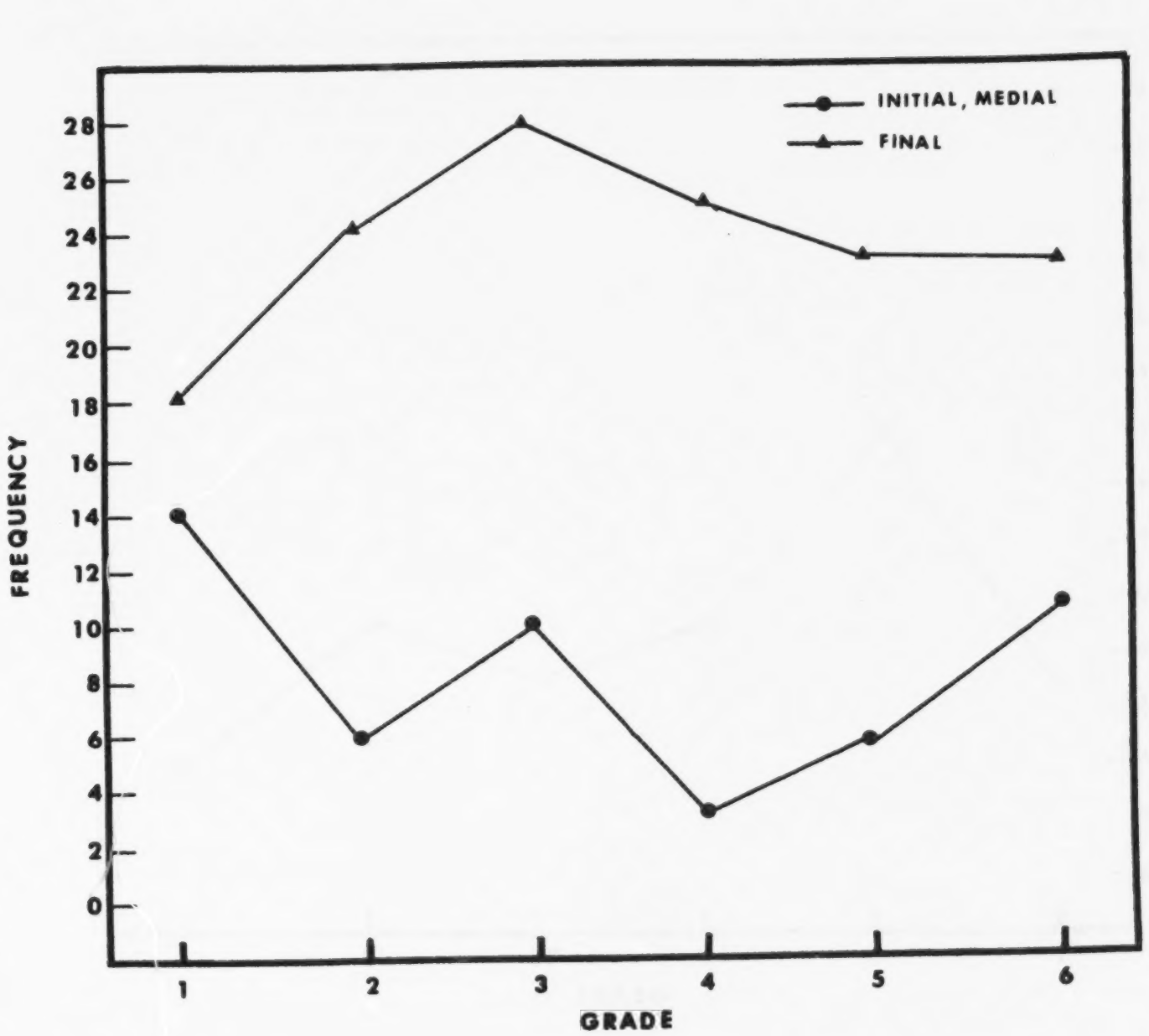
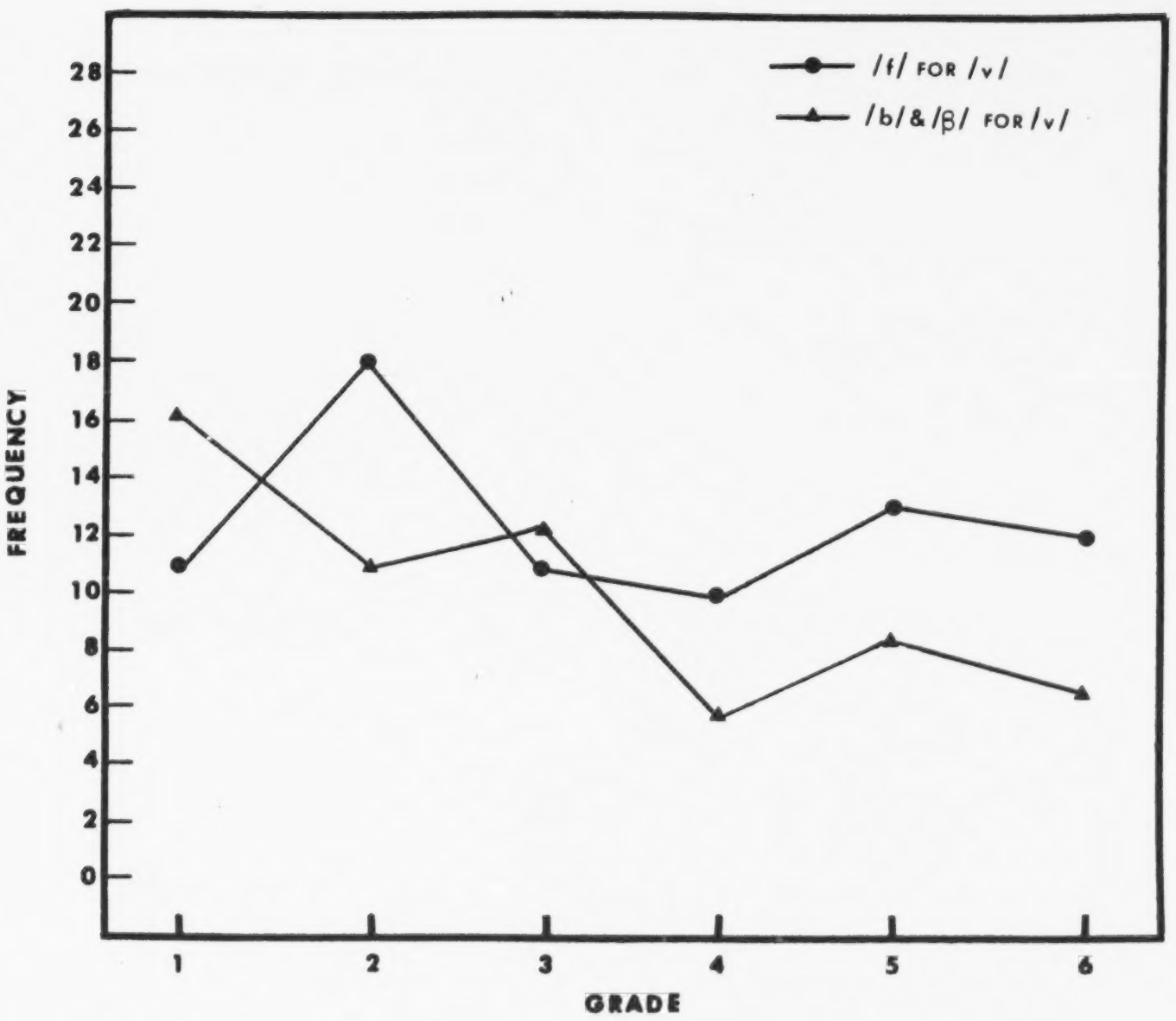


Figure 15

Incidence of /f/ for /v/ (Final Position) and /b/ (or /β/)
for /v/ (Initial and Medial Positions) Substitutions
by Grade for MAE Group



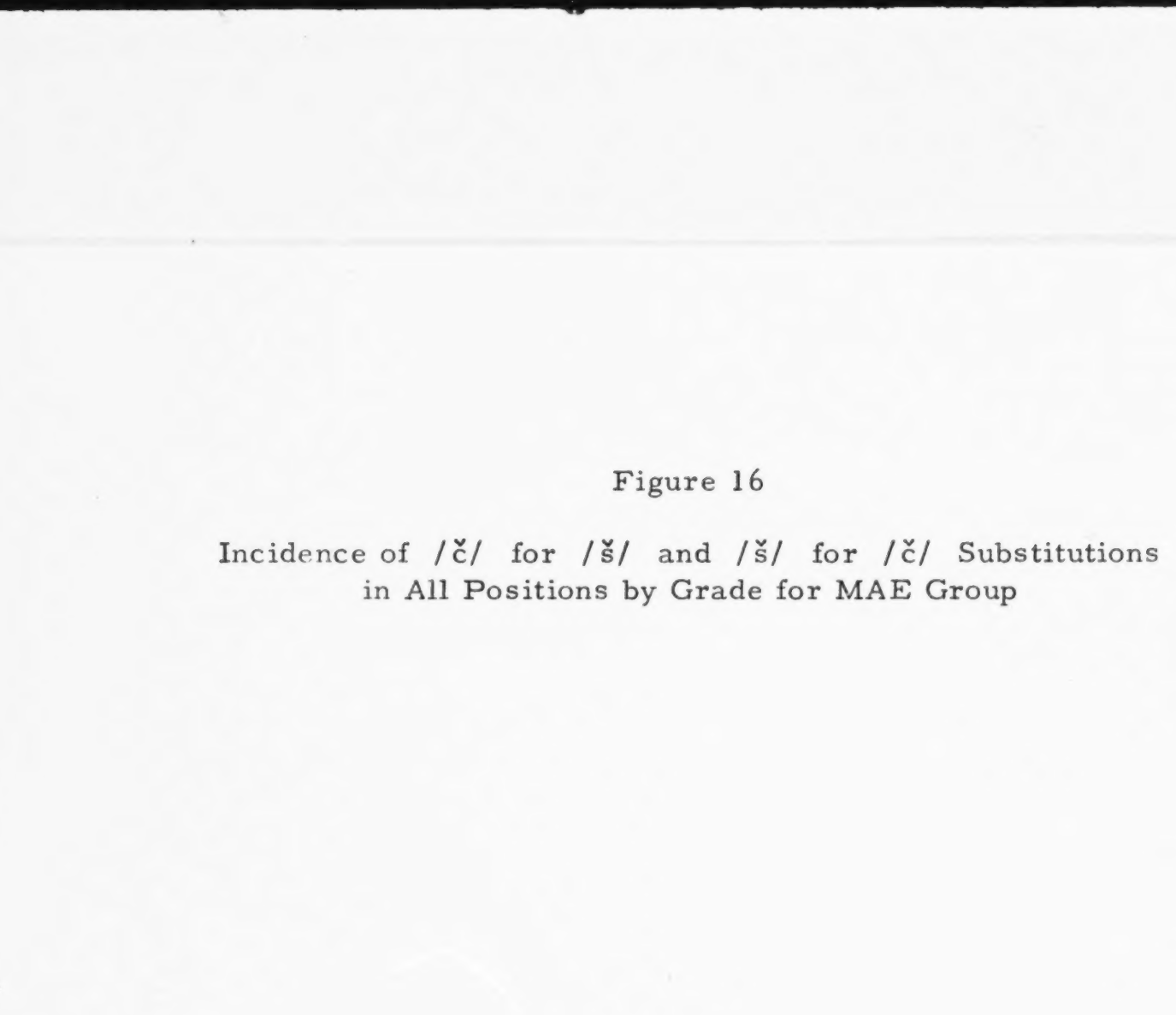
either /b/ or /β/ (a voiced bilabial fricative which occurs in Spanish, but not in English). The subjects sometimes produced full stops (/b/) and perceptible fricatives (/β/), but many of the substituted sounds had qualities of both. The result was that coding (by native speakers of English) was rather arbitrary. Therefore, /b/ and /β/ substitutions have been added together for presentation here. Substitutions of /b/ and /β/ for /v/ in initial and medial positions show a definite decreasing trend across grades. This trend is reflected in a χ^2 of 16.6, p = .006.

Figure 16: The almost identical overall frequency of /č/ for /š/ and /š/ for /č/ substitutions (in all positions) is shown in this figure. Statistical tests reveal, however, that while the distribution of /č/ for /š/ substitutions does not differ from chance, the /š/ for /č/ distribution does (χ^2 = 14.4, p = .01). This difference is manifested by a pattern of general decrease in frequency across grades. Thus, while the overall frequencies of these two common substitutions are similar, they seem to have differential patterns across grades.

In the next section the linguistic and socio-linguistic implications of results reported above will be discussed.

Figure 16

Incidence of /č/ for /š/ and /š/ for /č/ Substitutions
in All Positions by Grade for MAE Group



SECTION 5

DISCUSSION

The purpose of this section is three-fold. First, predictions of variants derived from an earlier study (Williams, et al., 1971) and from published literature on BE and MAE will be evaluated in the light of the present findings. Second, the implications of the present results for sociolinguistics, or dialect study, will be discussed. Third, speculations about the relationship between these data and general linguistic theory (as presented in Appendix A) will be presented.

5.1. Evaluations of Empirical Predictions

5.1.1. Substitutions occurring in SAE, BE, and MAE speech samples. The types of substitutions found in the three speech groups involved in this two-part study are compared in Table 11. Fourteen substitutions were found to be common to all three groups -- SAE, MAE, and BE. Another five substitutions are unique to the MAE and BE groups. One substitution is unique to the SAE group and another is unique (with one exception) to the MAE group. There are no substitutions unique to the BE group.

With one exception (the substitution of /b/ for /f/) all substitutions which appeared in the SAE sample also appeared in both the BE and the MAE samples. However, three of the substitutions which occurred with a relatively high frequency in the SAE and MAE groups (/s/ for /θ/, /d/ for /ǰ/, and /š/ for /č/) were rare among the BE speakers. The following five substitutions were found to be unique to the BE and MAE groups (i.e., these five substitutions did not occur at all in Marshalltown): four devoicing substitutions -- /k/ for /g/, /f/ for /v/, /t/ for /d/, and /p/ for /b/ -- and one other -- /d/ for /θ/. One very low frequency substitution, /š/ for /ǰ/, occurred in the SAE and MAE samples, but not in the BE sample. Because /š/ for /ǰ/ occurred only once in the Marshalltown data it was not considered a stable substitution in Williams, et al. (1971). Thus, it is almost unique to the MAE group.

With two exceptions, then, (/b/ for /f/ and /š/ for /ǰ/), Friedlander's (1965) findings are replicated. He reported that BE speakers produce all the variants produced by SAE speakers and MAE speakers produce all the variants produced by the BE speakers. This state of affairs means that there are no variants unique to BE. It would

Table 11

Comparison of Substitutions Occurring in SAE, MAE, and BE Groups

Substitutions Occurring in All Three Groups	
/s/ for /z/	/č/ for /ǰ/
/s/ for /θ/	/d/ for /ǰ/
/f/ for /θ/	/d/ for /ð/
/t/ for /θ/	/b/ for /v/
/t/ for /č/	/b/ for /p/
/š/ for /č/	/w/ for /r/
/č/ for /š/	/w/ for /l/
Substitutions Occurring in both MAE and BE Groups, but not in SAE Group	
/d/ for /θ/	/f/ for /v/
/k/ for /g/	/t/ for /d/
/p/ for /b/	
Substitution Occurring only in SAE Group	
/b/ for /f/	
Substitution Occurring only in MAE Group*	
/š/ for /ǰ/	
Substitution Occurring only in BE Group	
None	

*There is one exception to this statement. One such substitution was recorded in the SAE group.

also mean that there are no variants unique to SAE, either, but one of the two exceptions (/b/ for /f/) does appear to be unique to the SAE sample. Only one substitution (/š/ for /ǰ/) emerges as unique to the MAE sample (although it does occur once in the SAE group). There are, however, five substitutions which are unique to the non-SAE groups. These variants will be discussed further below.

5.1.2. Predictions derived from published literature on BE and MAE. Section 2 of this report presented relevant findings from a number of recent studies of BE and MAE. These findings were then used as a basis on which to expect certain phonetic variants in the BE and MAE samples. Before the outcome of these expectations is discussed, it should be pointed out that within BE and MAE there are "sub-dialects", corresponding to geographical location and, in the case of MAE speakers, to the dialect of Spanish which is their native language. Thus, findings based on studies of individual geographical areas should not be expected to yield perfect prediction for other geographical areas.

5.1.2.1. Predictions for BE group. The omission and devoicing of final consonants, especially stops, was correctly predicted for the BE group. In BE there are two sources of word-final omission. First, there is the omission of the last segment of a word-final cluster in which both segments of the cluster share the same voicing value. Thus, "hand" (in which both segments of the final cluster are voiced) is pronounced in BE as "han" and "desk" (in which both segments of the final cluster are unvoiced) is pronounced "des". Unfortunately, there are no such final clusters on the Goldman-Fristoe test. Therefore, the Goldman-Fristoe data for word-final omission of stops does not include omissions in this phonological environment. (Omissions of this type were observed frequently in the Free Speech samples of the BE speakers.) Omission of post-vocalic consonants has been emphasized much less in the literature, but is mentioned in Section 2 as a possible characteristic of BE. All omissions of word-final stops reported from the Goldman-Fristoe test are, in fact, post vocalic. Thus, this expectation is borne out by the data. Had final clusters been present in the Goldman-Fristoe test, however, the omission of final stops would undoubtedly have been much higher. It is important to note, with reference to Figure 1, that the final stop omissions included in that developmental pattern are post-vocalic stops. It is quite possible that the omission of stops in final clusters would have been found to follow a dialect pattern.

Omission of /ʃ/ and /l/ were found, as anticipated. These omissions were particularly frequent in final position, in which they followed a dialect pattern (see Figures 2 and 3). The substitution of /f/ for /θ/ occurred frequently, especially in medial and final positions, as predicted. The substitution of /d/ for /ð/ was also prevalent in the

Niagara Falls data. The only predicted variant which did not occur in the Goldman-Fristoe data was the substitution of /v/ for /ð/ in medial position. This substitution did occur, however, five times in the Free Speech sample.

5.1.2.2. Predictions for MAE group. Turning to the MAE sample, the predicted substitution of /b/ and /β/ for /v/ occurred with great frequency, but the substitution of /v/ for /b/ was almost non-existent. The articulatory confusion of /č/ and /š/ and the substitution of /s/ for /z/ occurred as predicted. There were some /ž/ and /y/ substitutions for /ǰ/, as predicted, but /ž/ for /ǰ/ appeared in all positions, not just in medial position. The /y/ substitution occurred in medial position, rather than in initial position, as predicted. No variants of /h/ were found, though the substitution of /x/ (an unvoiced velar fricative) was predicted. Neither did the coders misperceive an unaspirated initial voiceless stop as a voiced one. No substitution of a voiced for a voiceless initial segment was recorded.

The devoicing of final obstruents which was prevalent in the MAE sample was not predicted by the literature reviewed in Section 2; neither was the substitution of /š/ for /ǰ/. This latter substitution, while not frequent, is interesting because it is the only substitution unique to the MAE sample.

5.2. Sociolinguistic Implications

Hitherto in this report we have been referring to those phonemena characteristic of BE and/or MAE as "dialect" phenomena. To be more precise it is necessary to distinguish between those phenomena which are the result of phonetic interference from a primary language and those which are truly dialect phenomena, in which case the children are presumably mono-lingual. The data concerning obstruent devoicing, which is characteristic of both the Black and Mexican-American sample, illustrate this distinction most clearly. As mentioned above, previous authors have noted that word-final obstruent devoicing is characteristic of Black dialect. The present data show that the incidence of word-final obstruent devoicing increases with grade level in the Niagara Falls sample for all word-final obstruents. On the other hand, the frequency pattern of obstruent devoicing across grades is erratic in the San Antonio group. The incidence of some devoicing substitutions seem to decrease with grade level (see Figure 11), others are erratic (see Figure 13), and still others show a U-shaped distribution (see Figure 10).

This patterning difference across grades is indicative of the distinction between dialect and interference phenomena. Data from the BE group show that the children are acquiring a characteristic of their dialect

as they age. Presumably the correct linguistic description of this state of affairs is that this dialect contains a phonological rule which devoices word-final obstruents. The increasing incidence of the substitution of voiceless for voiced obstruents in word-final position, then, would reflect the individual child's acquisition of this rule of his dialect.

It should be pointed out that a word-final devoicing rule is very common among languages of the world. It occurs in a number of other Indo-European languages (e.g., German and Russian), as well as in unrelated languages. This rule may be a reflection of a tendency noted by some authors (Greenberg, 1969) toward weakening of segments in final position. In any case, it is entirely natural for a dialect to develop such a rule.

On the other hand, devoicing phenomena in the MAE sample, since they do not show a consistent increase in frequency over time do not seem to be the result of rule acquisition. We suggest, instead, that it may be due to the child's uncertainty as to the appropriate voicing values associated with particular lexical items. This is a plausible hypothesis in view of the fact that there are phonetic reasons why the perception of the voiced-voiceless distinction in English may be difficult for speakers of Spanish. Although this distinction exists in both Spanish and English, the cues for the perception of voiced and voiceless obstruents differ in the two languages. This is true because the phonetic correlates of voicing in English and Spanish differ from each other. Thus, for example, in English, vowels which precede voiced obstruents are typically longer and more tense, whereas in Spanish all vowels are tense. Furthermore, in English, voiceless phonemes are aspirated in some environments, whereas this is not the case in Spanish. The above is by no means a complete description of the differences between the English and Spanish manifestations of the voiced vs. voiceless distinction in obstruents. Suffice it to say, however, that the phonetic rules for realizing this distinction are considerably different in the two languages. If the Spanish-speaking child were to apply the perceptual cues appropriate for Spanish when attempting to distinguish between English voiced and voiceless obstruents, he would make many perceptual misjudgments. Thus, the random pattern of obstruent devoicing in MAE may be due to the speaker's uncertainty as to the appropriate phonetic value for the word being produced.

Another example of variants not deriving from rule differences, but, instead, from phonetic interference from the native language is the confusion between /š/ and /č/ in the MAE group. In all positions the substitution of /č/ for /š/ as well as of /š/ for /č/ is very common. Spanish does not distinguish between /š/ and /č/ -- in fact, /š/ does not occur in native Spanish words. As the Spanish-speaking child learns

English, he learns to produce the foreign phoneme /š/. Furthermore, he learns that the /š/ - /č/ distinction exists in English. Since Spanish remains the child's native language, however, he may never acquire the phonetic skills necessary for consistently correct application of the distinction. From the point of view of the MAE speaker, the English speaker is perceived as indiscriminantly producing sometimes /š/, sometimes /č/. Since there are no rules to govern the distribution of these sounds, the MAE speaker may also indiscriminately substitute one for the other. When he substitutes an /š/ for a /č/ we have an example of over-correction. Figure 16 illustrates that as the child exposure to English increases the incidence of over-correction decreases, although the substitution of /č/ for /š/ (which may be interpreted as a lapse into the Spanish phonological pattern) decreases far less. The frequency levels of both these substitutions remain high, however, and it is known that these substitutions are extremely common in MAE spoken by adults.

The substitution of /š/ for /ǰ/ (which only occurs in final position) is an example of the same mechanism. The obstruent devoicing which is common in MAE results in the interpretation of /ǰ/ as a /č/ and, thus, subject to the same alternation with /š/ as is /č/.

5. 3. Implications for Linguistic Theory

A major goal of the pair of studies consisting of the present study and Williams, et al. (1971) has been to relate facts about the articulatory performance of selected groups of children to general linguistic theory. In this section aspects of the present data which appear relevent to such an interpretation will be discussed.

While the pattern of substitutions for /θ/ in the MAE and BE data is in general consistent with the interpretation presented in Williams, et al. (1971, page 70), the BE data of the present study is perhaps most revealing on this point. The substitution of /f/ for /θ/ is by far the most common variant in the entire BE sample. This is consistent with the claim made in Williams, et al. (1971) that the features of non-stridency and continuance dominate the more vulnerable feature [coronal]. Thus, the features [-strident] and [+continuant] are maintained in the /f/ for /θ/ substitution, while the value of the feature [coronal] changes from $\underline{+}$ to $\underline{-}$. This feature change is also consistent with the general hypothesis derived from markedness theory (see Appendix A) that as features change to effect substitutions, there is a tendency for the change from their marked to their unmarked value. In the /f/ for /θ/ substitution, the vulnerable feature [coronal] changes from its marked to its unmarked value.

The behavior of /θ/ in MAE does not fit this pattern as neatly as does the /θ/ in the BE group. In the MAE data, in particular, the frequent substitution of /s/ and /t/ for /θ/ can be largely accounted for by phonetic interference. Similarly, the substitution of /s/ for /z/ in both sets of data is consistent with the hypothesis put forth to explain the data in Williams, et al. (1971), namely, that there is a strong tendency toward preserving the stridency feature value at the expense of features which might attenuate the perceptibility of stridency. Thus, voicing, by reducing intraoral air pressure, detracts from the noisiness of a fricative, making it less strident than its voiceless counterpart.

Another conclusion from the Williams, et al. (1971) study which is substantiated in the present study is that the class of substitutors is distinct from the class of substitutees. There is one apparent class of exceptions to this, however: the voiced obstruents /d/, and /b/, which are common substitutors, appear in this study to be sometimes substituted for by their voiceless counterparts (in final position). However, we have suggested above that this voiced/voiceless alternation in BE is a result of the acquisition of a regular phonological rule and in the case of MAE the result of phonetic interference. Since in both cases we have independent evidence for arguing that the voiced/voiceless alternation is not a result of immaturity of the articulatory apparatus, the general conclusion that the substitutors are drawn from the class of sounds which does not include the substitutees remains valid for substitutions having a developmental origin.

Examination of the present data in the light of a theory of phonology which incorporates the ideas of markedness (see Appendix A) reveals that almost all substitutions not accounted for by first language interference are effected by the change of a feature from its marked to its unmarked value. One apparent counter-example to this is the substitution of /b/ for /v/[1] which entails the change of the feature [coronal] from U to M. Note that this does not entail the change of the +/- value of [coronal]. It is considered that bilabial, non-strident fricatives are unmarked for [coronal], whereas bilabial stops are marked for [coronal]. We might qualify the above statement, then, by stating that every change in the +/- value of a feature is always in the direction of the features becoming

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[1]The /b/ for /v/ substitution in the MAE group would not be a counter-example to the markedness claim because in that group the substitution can be accounted for by phonetic interference. It is only among the BE and SAE groups that the /b/ for /v/ substitution constitutes an apparent counter-example to the markedness prediction.

unmarked. The only counter-example to this modified claim is the substitution of /b/ for /p/ in initial position. It should be noted that this occurs only in the word "pajamas" in the Goldman-Fristoe test. In this word the initial segment precedes an unstressed vowel which, in turn, precedes a voiced obstruent in a stressed syllable. It is likely that in the production of this word the phonetic phenomenon known as co-articulation (see Ohman, 1966 and Perkell, 1969) is taking place. On this view, the speaker would be setting his larynx for phonation at the beginning of the word in anticipation of what is required for the production of the stressed syllable. Had the test included a word such as "potato" or "palace" we suspect that the initial /b/ for /p/ substitution would not have occurred.

In summary, it appears that markedness theory is useful in explaining some of the substitutions which occur in MAE and BE. It is important to note, however, that markedness theory is of no utility in explaining the substitutions which result from phonetic interference. It appears that the clearest example of dialectal variation, namely word-final obstruent devoicing, is compatible with markedness theory because voicing is marked in obstruents. This compatibility, however, may be illusory, since not all language change can be explained by such a straightforward application of markedness theory. Therefore, it appears that three basic factors can explain the data in this study: (1) Phonetic interference; (2) Dialect variation; and (3) Maturational factors which seem to be consistent with markedness theory.

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APPENDIX A

Appendix A of the present report consists of a reproduction of Section 2, "Linguistic Perspectives," from Williams, et al. (1971), the report of the initial study of this series of two studies.

Notice that the tables of this Appendix (since it was originally a section from another report) are numbered as they were in the original report. The Appendix refers only to its own internal tables.

Linguistic Perspectives[1]

Although the present study involved identification and tabulation of articulatory substitutions, a major theoretical focus was upon the interpretation of the substitutions relative to contemporary phonological theory. Since theories of phonology purport to explain regular aspects of the sound structure of language, it is natural to expect that regular aspects of articulatory errors could be explained in terms of a phonological theory. For reasons which will be discussed below, the theory of generative phonology, as adapted to include the concept of markedness, is judged to be most adequate for this purpose (Chomsky and Halle, 1968, Chapter 9).

1. Phonetic Features

1.1. Phonetic features in phonological theory. Phonological theory seeks to characterize, for any language, the inventory of phonological segments (phonemes) in that language. Contemporary phonologists generally accept the view that the ultimate unit of phonological analysis should not be the individual phoneme, but rather the phonetic features of which the phonemes are constructed. Table 1 presents brief descriptions of the features used to describe the phonetic content of English phonemes. Notice that many of the features correspond to traditional parameters of phonemic description, such as place and manner of articulation. Table 2 presents a matrix displaying the feature values associated with each consonant analyzed in the present study.

These features frequently refer to the presence or absence of articulatory properties, such as nasality or voicing or the involvement or noninvolvement of the corona of the tongue. In other cases, the +/- values reflect the extreme values of a feature (such as backness for the vowels) which range over a continuum and serve to classify phonemes relative to other phonemes. For example, both /u/ and /a/ are classified as [+ back], although /a/ involves more tongue

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[1] This section was prepared by C. Cairns and H. Cairns.

Table 1

Phonetic Features

Feature	Description
Consonantal (cns)	A speech sound is consonantal if it is produced with a constriction along the center line of the oral cavity. Only the vowels and the glides (/w/, /h/, and /y/) are nonconsonantal.
Vocalic (voc)	Vocalic sounds are those which have a largely unobstructed vocal tract. The liquids /l/ and /r/, which are consonantal, are also vocalic. This is true because while there is a central obstruction for the liquids, there is a large unobstructed area to either side of the tongue. Although there is no central obstruction for glides, the most narrow area in the vocal tract during the production is not large enough to qualify them as vocalic. The glides, therefore, are nonvocalic.
Anterior (ant)	A sound is anterior if the point of articulation is as far front in the oral cavity as the alveolar ridge. Thus, all the labial and dental sounds are anterior, while sounds produced farther back are nonanterior.
Coronal (cor)	A sound is coronal if its articulation involves the front (or corona) of the tongue. A sound is non-coronal if another part of the tongue is used (such as in /k/) or if the tongue is not involved in the production of the sound at all (such as in /p/).

Table 1 (cont'd)

Feature	Description
Continuant (cnt)	A sound is noncontinuant if it is produced with a complete obstruction in the oral cavity. Only the nasals, stops and affricates are noncontinuant. (The nasals are considered to be noncontinuant because while there is an opening in the nasal cavity, the oral cavity is completely obstructed.)
Strident (str)	A strident sound is produced by an obstruction in the oral cavity which forces the air through a relatively long, narrow constriction. As the air rushes out of the opening of this construction, its turbulence serves as a primary noise source. This turbulent air is then directed against a second obstruction which causes a secondary noise source.
Voice (voi)	Voiced sounds are those in which phonation (vibration of the vocal folds in the larynx) takes place as the sound is articulated.
Lateral (lat)	A lateral sound is one which involves a contact between the corona of the tongue and some point on the roof of the mouth, along with a simultaneous lowering of the sides of the tongue. In English, /l/ is the only lateral sound, and this feature differentiates it from /r/, the only other liquid, which is nonlateral.

Table 1 (cont'd)

Feature	Description
Nasal (nas)	Nasals are characterized by a lowering of the velum, which opens the nasal cavity for sound resonation.
	The above features are used for the description of consonants in English. Hence, they are the only features used for analysis in the present study (cf. Tables 1 & 3). For the sake of completeness, however, the following features for vowel classification are also presented.
High	High vowels are those which involve the highest tongue position, and thus the narrowest constriction in the oral cavity. /u/ and /i/ are the only high vowels; all others are nonhigh.
Low	Low vowels are those which involve the lowest tongue position, /ae/, /a/, and /ɔ/. All other vowels are nonlow. Note how the so-called middle vowels are classed in this system; /e/ and /o/ are nonlow and nonhigh.
Back	The traditional back-front distinction is accounted for the back/nonback distinction. Thus, /u/, /o/, and /ɔ/ are classed as back, while /i/, /ae/, and /e/ are nonback.
Round	As in traditional classifications, the rounding of the lips is a feature for vowel differentiation. Thus, /u/, /o/, and /ɔ/ are round. Others are nonround.

Table 2

Feature Content of Phonemes

Features	Phonemes																						
	z	s	ʒ	θ	d	t	v	f	b	p	$\overset{v}{s}$	$\overset{y}{j}$	$\overset{v}{c}$	g	k	w	h	y	l	r	m	n
Consonantal	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+	
Vocalic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	
Anterior	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	+	+	+	+	
Coronal	+	+	+	+	+	+	-	-	-	-	+	+	+	-	-	-	-	+	+	+	-	+	
Continuant	+	+	+	+	-	-	+	+	-	-	+	-	-	-	-	+	+	+	+	+	-	-	
Strident	+	+	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	
Voiced	+	-	+	-	+	-	+	-	+	-	-	+	-	+	-	+	-	+	+	+	+	+	
Lateral	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	
Nasal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	

193

retraction than /u/ does. /u/ is classified as [+ back] to distinguish it from /i/ (the only other [+ high] vowel), while /a/ is classified as [+ back] to distinguish it from /ae/ (the only other [+low] vowel). The major point here is that for the purposes of classifying all the phonemes of a language, +/- values are referred to, rather than degrees of realization of individual features.

1.2. Phonetic features in the present study. Phonologists have shown that analyzing phonemes as bundles of features leads to more theoretically parsimonious and adequate phonological analyses.[2] A more pertinent question, however, is -- how does the feature approach aid a study such as the present one, which deals with articulatory errors? Suppose that two children misarticulated the phoneme /z/. Child A substituted /s/ for /z/ and Child B substituted /t/ for /z/. If the basic unit of analysis is the individual phoneme, then there is no principled basis for claiming that one substitution is any "closer" to the target phoneme (/z/) than the other, nor is there any general way available to classify the substitutions. Analyzing the substitutions as feature changes, however, is much more informative. Turn to Table 2 and examine the feature content of /z/, /s/, and /t/. The column of pluses and minuses below /s/ differs from that of /z/ by only one cell ([-voice] for /s/; [+voice] for /z/). This means that /s/ and /z/ have the same value for every feature other than [voice]. /t/ and /z/, on the other hand, differ by three feature values. Like /s/, /t/ is [-voice], but, in addition, /t/ is [-strident] while /z/ is [+strident] and /t/ is [-continuant] while /z/ is [+continuant]. (For a description of the features involved, see Table 1.) Therefore, it can be said that /s/ differs from /z/ by only one feature, while /t/ differs from /z/ by three features. The /s/ for /z/ substitution could be said to represent a smaller degree of error than the /t/ for /z/ substitution.

Note that a /d/ for /z/ error is in between the other two substitutions in distance from the target sound, as /d/ differs from /z/ by only two features ([continuant] and [strident]). Thus, use of features seems to provide a metric by which we can judge the degree of an articulatory substitution error.

Another advantage in using the feature approach to interpret articulation errors is that it provides a definition of general classes of errors. (These error classes correspond to "natural classes" of

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[2]This discussion will not include phonological arguments for the use of feature systems. The interested reader is directed to a classic article on the subject, Halle, 1964.

phonemes in phonological theory, which will be discussed later.) There are, for instance, eight substitutions which involve only a change from [+voice] to [-voice]. They are /s/ for /z/; /θ/ for /ð/; /t/ for /d/; /f/ for /v/; /p/ for /b/; /č/ for /ǰ/; /k/ for /g/; and /h/ for /w/. It is readily apparent that a very large number of classes of errors can be defined using the feature system. Thus, the feature approach provides an informative, quantifiable framework within which to investigate substitution errors.

2. The Concept of Markedness

As was discussed above, the use of a feature analysis of individual phonemes allows the researcher to distinguish classes of phonemes (and classes of substitution errors). For example, one can refer to the class of "all voiced sounds," i.e. all those phonemes which are [+voice]. In the terminology of phonological theory this grouping by features is referred to as the grouping of the phonemes into "natural classes." Phonologists expect that the phonemes grouped into "natural classes" by features will also evidence similar behavior in phonological processes. That is, phonological rules will apply to all the phonemes which are members of a natural class. A phonological rule would never apply only to /k/, for instance, but to all other voiceless stops as well.[3] Analogously, one would expect that classes of phonemes would be similarly affected by substitution errors. Unfortunately, however, the use of +/- values for features often leads to unsatisfactory groupings into natural classes.

A large natural class defined by +/- feature values is the class of all voiced segments (all phonemes which are [+voiced]). This class includes all voiced obstruents (obstruents are phonemes which are [+consonantal], [-vocalic], and [-nasal], cf. Table 4), all nasals, glides (/w/ and /h/), liquids (/r/ and /l/) and vowels. (Nasals, glides, liquids and vowels are referred to as "sonorants.") It is expected, then, that the voiced obstruents and the sonorants,

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[3] An excellent example of the unitary phonological behavior of members of a natural class is word-final devoicing in German. All members of the class of voiced obstruents change from [+voice] to [-voice] when they appear in word-final position. Thus, the morpheme "Bad" (bath) becomes /bat/ when there is no inflectional ending. The presence of a stem-final /d/ in the underlying representation of this stem is revealed by the phonetic form when there is an inflectional ending, e.g., /baden/ (plural form).

since they form a natural class of all voiced segments, would function similarly in phonological processes and in articulation errors. This is not the case, however. Phonologically, voiced obstruents behave as a class and participate in phonological processes not involving the sonorants (cf. footnote 2). In articulatory errors, devoicing (a change from [+voice] to [-voice], as in the /s/ for /z/ substitution) is only associated with the voiced obstruents. Vowels, glides, nasals and liquids are never devoiced. In fact, very few languages of the world contain voiceless sonorants in their phonemic inventories. A system is needed which will allow the voiced obstruents and the voiced sonorants to be separated into two different natural classes. It would not do, however, to eliminate the +/- feature system entirely, because the +/- values are necessary to describe the phonetic content of phonemes.

The solution is to add another system which will describe the relationship between a particular feature and the other features in the phoneme within which it occurs. Consider again the feature [voice]. Articulatorily, the production of voicing in obstruents involves more articulatory complexity than does the production of voicing in sonorants. This is so because for phonation (voicing) to take place there must be a stream of air passing through the larynx. The production of an obstruent, however, involves the creation of an obstruction in the oral cavity, coupled with the closure of the velum, (recall that obstruents are [+consonantal], [-vocalic], and [-nasal]) thus creating an impediment to the stream of air. Since the introduction of an obstruction in the oral cavity and the closure of the velum causes supra-glottal air pressure to rise as air passes through the larynx, phonation during the production of an obstruent requires extra articulatory effort. In the case of the sonorants, however, there is a large open cavity above the glottis (the oral cavity in the case of vowels, glides and liquids -- the nasal cavity in the case of nasals), so supra-glottal air pressure does not increase as air passes through the larynx, and voicing occurs spontaneously, with no extra effort on the part of the speaker. In fact, the suppression of voicing requires extra articulatory effort. Thus, a voiced obstruent is a more complex phoneme than a voiced sonorant.

The system which has been devised to capture relationships of this sort is the system of marking (Cairns, 1969; Chomsky and Halle, 1968, Chapter 9). In this system each feature is assigned a marked (M) or unmarked (U) value. Table 3 presents the same phonemes as those presented in Table 2, with M/U feature values specified, rather than +/- values. Notice that obstruents which are [+voice] on Table 2 (/z/, /ʒ/, /d/, /v/, /b/, /ǰ/, and /g/) are [M voice] on Table 3. On the other hand, the sonorants which are [+ voice] on Table 2 (/w/, /j/, /l/, /r/, /m/, and /n/) are [U voice] on Table 3. (If vowels were

Table 3

M/U Feature Values of Phonemes

Features	Phonemes																					
	z	s	ʒ	ʤ	d	t	v	f	b	p	v s	y j	v c	g	k	w	h	y	l	r	m	n
Consonantal[a]	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	+	+	+	+
Vocalic	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	M	M	M	M	M	U	U
Anterior	U	U	U	U	U	U	U	U	U	U	M	M	M	M	M	U	U	U	U	U	U	U
Coronal	U	U	M	M	U	U	U	U	M	M	M	M	M	U	U	U	U	M	U	U	M	U
Continuant	M	M	M	M	U	U	M	M	U	U	M	U	U	U	U	U	U	U	U	U	U	U
Strident	U	U	M	M	U	U	M	M	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Voiced	M	U	M	U	M	U	M	U	M	U	U	M	U	M	U	U	M	U	U	U	U	U
Lateral	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	M	U	U	U
Nasal	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	M	M
Complexity	2	1	4	3	1	0	3	2	2	1	3	3	2	2	1	1	2	2	2	1	2	1

[a]Note that the feature 'consonantal' does not take on marked and unmarked values. This is because the conversion of M's to U's for all features is dependent upon the +/- value of the feature 'consonantal'. See the Interpretative Conventions presented in Table 4 (page 201).

included in these two tables, they would be [+voice] on Table 2 and [U voice] on Table 3.) Table 2, then, reflects a +/- value system which describes the phonetic content of the phonemes while Table 3 reflects a marking system which expresses the relationship of the individual features to the phonemes in which they occur. The assignment of [M voice], therefore, is made whenever the articulatory adjustment to produce or suppress voicing involves more articulatory effort on the part of the speaker. (Recall that voiced obstruents and voiceless sonorants are [M voice], while voiceless obstruents and voiced sonorants are [U voice].)[4] The marking system of Table 3 also provides a natural class (all those phonemes which are [M voice]) including voiced obstruents and another natural class (all those phonemes which are [U voice]) which includes voiced sonorants.

Consider the previous example of an /s/ for /z/ substitution. Table 2 revealed that the substitution represents a change of one feature value ([+ voice] to [-voice]). Consultation of Table 3 shows that the value change is also from [M voice] to [U voice]; thus, the +/- system indicates that the substituted phoneme is only one feature distant from the target phoneme, while the M/U system indicates in addition that the substitution is a simplifying substitution. This is true because /s/ has fewer M's in its total inventory than does /z/ and also because the feature of [voice] is changed from its more complex to its less complex value. It is important to notice that the substitution is not simplifying just because the feature changes from a + to a - value. If an /h/ had been substituted for a /w/, this would also be a change of [+voice] to [-voice], but Table 3 reveals that such a substitution would not be a simplifying one, as it would involve a change from [U voice] to [M voice]. (Recall that /h/, which is voiceless, is marked for voicing because it is a sonorant; see footnote 4.)

2.1. A perceptual basis for marking. Marking may also reflect increased complexity attributable to perceptual factors. Three classes of phonemes are relevant to this discussion: (1) strident fricatives -- these are obstruents which are [+ continuant] and [+ strident] (/s/, /z/, /š/); (2) nonstrident (mellow) fricatives -- these are obstruents which are [+ continuant] and [- strident] (/ž/, /θ/, /f/, and /v/); and (3) pure (nonaffricated) stops -- these are obstruents which are [- continuant] and [- strident] (/d/, /t/, /b/, /p/, /g/, and /k/). The main perceptual cue indicating the presence of a pure stop seems to be a brief

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[4]Notice that the one voiceless sonorant under consideration, /h/, is in fact marked [M voice] on Table 2.

period of silence during the time of closure. Fricatives, on the other hand, are signaled by the presence of noise during the time of the consonantal obstruction, and strident fricatives are noisier than nonstrident fricatives. Therefore, the perceptual distinction between strident fricatives and stops is greater than that between nonstrident fricatives and stops. Thus, one might say that strident fricatives are optimal fricatives, whereas nonstrident fricatives are nonoptimal because their nonstridency tends to attenuate the perceptual distinction between the fricatives and the stops (Jakobson, 1941).

Note that in Table 3 the nonstrident fricatives are [M strident], while the strident fricatives are [U strident]. This marking reflects the fact that the nonstrident fricatives are nonoptimal and are more perceptually complex. The pure stops, of course, are [U strident]; their lack of stridency makes them perceptually optimal. [5]

Among the nonstrident fricatives, /f/ and /θ/ (and their voiced counterparts /v/ and /ð/) are distinguished from each other by point of articulation. According to the feature system employed here /θ/ and /ð/ are [+coronal], while /f/ and /v/ are [-coronal]. /f/ and /v/ are classified here as [M coronal], whereas /θ/ and /ð/ are [U coronal]. [6] Although this assignment of Ms and Us is not as certain as those assignments discussed above, there does seem to be some evidence for this marking. Among the evidence is the fact that several languages exist which contain an /f/ and a /v/ but do not contain a /θ/ and a /ð/, whereas few languages have a /θ/ and a /ð/, but not /f/ and /v/. Another consideration is the general opinion of speech therapists that labials are easier to articulate than lingual consonants.

2.3. Complexity. Since the assignment of an M value to a feature reflects relative articulatory or perceptual complexity, the

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[5] This illustrates an important point which must be borne in mind as Tables 2 and 3 are compared with each other. A feature which has a + value for a particular phoneme on Table 2 will not necessarily be marked with an M on Table 3 (nor will - values on Table 2 correspond invariably to a U on Table 3). If this were the case then there would be no point in having the marking system.

[6] The feature values serve to distinguish the phonemes from each other. The reader will notice that in both the M/U and the +/- matrices no two phonemes have the same set of feature values.

total number of Ms assigned to a particular phoneme can be said to characterize the total complexity of that phoneme. Moreover, the relative complexity of phonemes can be determined by comparing the number of M assignments of each, so that a phoneme with more Ms is more complex than one with fewer Ms. The bottom row of Table 3 displays the complexity value for each phoneme on the chart, derived by simply counting the number of Ms assigned to that segment.

2.4. Universal interpretative conventions. As was discussed above, the +/- system and the M/U system for assigning feature values are designed to reflect different kinds of facts about the individual features. It is apparent, however, that the two systems are not independent of whether its descriptive value is + or -. In phonologicial theory, therefore, there must be some description of the relationships between the two systems. That description must hold for all languages of the world (that is, it must be universal) or the M/U assignments could be made up separately for any individual language which was being studied. Table 4 presents the set of universal interpretative conventions which relate the M/U values of Table 3 to the +/- values of Table 2. The conventions are presented both in the formal notation of phonological theory mainly for the purpose of illustrating that notation. They are also verbally described in the same table.

3. Phonetic Features and Markedness as Related to the Present Study

It should be valuable to view articulatory substitutions as feature changes rather than as the substitution of one unitary phoneme for another. If this is the correct approach, an analysis of errors should indicate that many features of the target phoneme are retained and only a few are changed when a substitution occurs. This was discussed above as "degree of error" of the substitution. Using the feature as the primary unit of analysis allows the description of an error to include a statement about the "distance" of the substituted phoneme from the target phoneme.

The use of the M/U system to characterize feature values should make it possible to explain many substitution errors. One would expect that within phonemic classes more errors would be associated with the more complex (more marked) phonemes than with the less marked ones. It also seems reasonable to expect that when a substitution occurs, the substituted phoneme will be less marked (have fewer Ms) than the target phoneme which it replaces. When the individual features of the substitution are considered, the theory of complexity presented here predicts that the value changes which effect the substitution will be from M to U.

Table 4

Interpretative Conventions

Convention[a]	Formal Notation
1. The unmarked value of 'vocalic' is the opposite value of consonantal.	$[\text{U voc}] \rightarrow [-\alpha\ \text{voc}] / \left[\frac{\quad}{\alpha\ \text{cns}}\right]$
2. The unmarked value of 'nasal' is - .	$[\text{U nas}] \rightarrow [-\text{nas}]$
3. For all consonantal sounds, the unmarked value of 'anterior' is + .	$[\text{U ant}] \rightarrow [+\text{ant}] / \left[\frac{\quad}{+\text{cons}}\right]$
4. For true consonants (i. e. all [+cons] [-voc] sounds), the unmarked value of 'continuancy' is - .	$[\text{U cnt}] \rightarrow [-\text{cnt}] / \left[\frac{\quad}{\begin{matrix}+\text{cns}\\ -\text{voc}\end{matrix}}\right]$
5. The unmarked value of 'stridency' is the same as the continuancy feature for all nonnasal, true consonants (i. e., all obstruents). It is - for all other sounds.	$[\text{U str}] \rightarrow [\alpha\ \text{str}] / \left[\frac{\quad}{\begin{matrix}+\text{cns}\\ -\text{voc}\\ -\text{nas}\\ \alpha\ \text{cnt}\end{matrix}}\right]$
6. The unmarked value of 'coronal' is - for continuant, nonstrident sounds and for nonanterior sounds. It is + for all other sounds. (That is, /θ/ and /d/ are marked for coronal, although /t/, /d/, /s/, and /z/ are not. /f/ and /v/ are also not marked for coronal. The point is that /f/ and /v/ are the unmarked nonstrident continuants.	$[\text{U cor}] \rightarrow \left\{\begin{matrix}[-\text{cor}] / \left\{\left[\frac{\quad}{\begin{matrix}+\text{cnt}\\ -\text{str}\end{matrix}}\right]\right\} \\ \left[\frac{\quad}{-\text{ant}}\right] \\ [+\text{cor}]\end{matrix}\right\}$

Table 4 (cont'd)

Convention[a]	Formal Notation
7. An obstruent (i.e., a [+cns] [-voc] [-nas] sound) is unmarked for voicing when it is [-voi] all other sounds are [+voi] in the unmarked state.	$[U\ voi] \rightarrow \left\{ \begin{matrix} [-voi] / \left[\begin{matrix} \overline{\quad\quad} \\ +cons \\ -voc \\ -nas \end{matrix} \right] \\ [+voi] \end{matrix} \right\}$
8. The unmarked value of 'lateral' is - .	$[U\ lat] \rightarrow [-lat]$

[a]Note that these conventions must apply in the order in which they are written. For example, '1' must have applied to give a '+' or a '-' value for the feature 'vocalic' before conventions '2,' '5,' or '7' can apply.

The interpretative conventions are written in terms of the U value for each feature. The M value assumes exactly the opposite +/- value from that assumed by the U value. Thus, for example, in convention #8, [U lat] is related to [-lat] and [M lat] is related to [+ lat].

A point which has not been mentioned is the importance of the individual features. All the discussion up to this point has seemed to indicate that [strident], for instance, is as important a feature as [anterior]. Actually, very little is known about the relative importance of the features, but one might speculate that a feature like stridency, which is very distinctive perceptually, might be more important (or carry more information) than the features which specify place of articulation. This is the sort of information which could be provided by a study of articulatory substitutions. If some features seem more vulnerable to value changes than others, then the more stable ones can be characterized as more important. The vulnerability of a feature will probably be related to whether it is marked (since feature changes are expected to be from an M value to a U value) and also to the values of other features with which it interacts.

APPENDIX B

Frequency of Occurrence of Target Phonemes on the Goldman-Fristoe Test of Articulation

Target	Position	f	Words
	i	1	zipper
z	m	1	scissors
	f	4	scissors, matches, pencils, Claus
	i	2	scissors, Santa
s	m	2	pencils, Christmas
	f	2	house, Christmas
	i	1	vacuum
v	m	1	shovel
	f	1	stove
	i	1	shovel
š	m	1	fishing
	f	1	brush
	i	3	bathtub, bath, bed
b	m	1	rabbit
	f	1	bathtub
	i	1	this (or that)
ð	m	1	feather
	f	0	
	i	1	jumping
ǰ	m	1	pajamas
	f	1	orange

Target	Position	f	Words
	i	1	thumb
θ	m	1	bathtub
	f	1	bath
	i	1	pencils
p	m	3	zipper, jumping, sleeping
	f	2	cup, lamp
	i	1	gun
g	m	1	wagon
	f	1	flag
	i	1	duck
d	m	1	window
	f	1	bed
	i	2	chicken, church
č	m	1	matches
	f	1	church
	i	1	telephone
t	m	2	bathtub, Santa
	f	2	rabbit, carrot
	i	3	fishing, feather, finger
f	m	1	telephone
	f	1	knife
	i	3	cup, car, carrot
k	m	2	chicken, vacuum
	f	1	duck
	i	1	knife
n	m	5	window, cleaner, pencils, orange, Santa
	f	5	telephone, gun, wagon, chicken, plane

Target	Position	f	Words
	i	1	matches
m	m	2	lamp, jumping
	f	3	vacuum, thumb, drum
	i	2	rabbit, ring
r	m	2	carrot, orange
	f	0	
	i	0	
ʤ	m	4	scissors, church, squirrel, airplane
	f	5	zipper, cleaner, car, feather, finger
	i	1	lamp
ℓ	m	2	telephone, yellow
	f	3	wheel, squirrel, pencil
	i	1	house
h	m	0	
	f	0	
	i	2	window, wagon
w	m	0	
	f	0	
	i	1	yellow
y	m	0	
	f	0	

Below are the clusters appearing on the Goldman-Fristoe. All are morpheme initial and there is one instance of each.

pℓ	airplane
br	brush

Target	Words
bℓ	blue
dr	drum
fℓ	flag
kℓ	Claus
kr	Christmas
tr	tree
skw	squirrel
sℓ	sleeping
st	stove